THE IRON TRADE REVIEW

VOLUME XXII. CLEVELAND, O., MAY 30, 1889. NUMBER 22.

THE IRON TRADE REVIEW.

A JOURNAL OF THE
IRON AND STEEL INDUSTRY, THE MACHINERY TRADE AND KINDRED INTERESTS.
IS PUBLISHED EVERY THURSDAY BY THE

CLEVELAND PRINTING AND PUBLISHING CO.,

Corner St. Clair and Wood Streets, Cleveland, O.

TERMS, (strictly in advance):

One year	$3 00
Six months	1 50
Three months	75

Advertising Rates Furnished on Application.

ENTERED AT THE POSTOFFICE AT CLEVELAND, O., AS SECOND CLASS MATTER.

CLEVELAND, O., MAY 30, 1889.

THE WEEK IN IRON CIRCLES.

General Features. Trade conditions offer few features worthy of comment this week. There is the same general lassitude, and the same universal inquiry, "What next?" There are present none of the conditions of a panic, and no one can be found who does not predict an early change for the better. But still the favorable turn holds off, so far as iron and steel manufacturers are concerned, and trade appears to be engaged in adjusting itself to new and somewhat unexpected conditions. The effort to secure lower freight rates on coke, by Cleveland furnace-men, has not borne fruit as yet, but it is clear that, a concession having been made to Pittsburgh in the matter of ore rates, a like reduction as to coke is demanded by both justice and equity. The general iron trade seems to be active, machine shops and foundries being quite busily engaged. A meeting of wire nail manufacturers was held in Cleveland, the past week, at which a satisfactory schedule of prices was adopted. The Cut Nail Association met at Wheeling, on Thursday of last week, and devised various changes in existing regulations tending to strengthen the present pool. Quite a run of small orders for steel rails is reported, but no business of moment. The coke trade is fairly active, and there is renewed talk of advancing the price from $1.00 to $1.25. Production is heavier than for some weeks past, 10,884 out of the 13,266 ovens in the Connellsville region being reported in blast. Lake Superior iron ore shipments, up to May 22, aggregated 636,111 tons, against 215,012 tons up to the corresponding date of last year. Our advices from Cincinnati are to the effect that the past week has witnessed probably the lowest sales in both Southern and Northern iron that have been made this year, and lower, undoubtedly, than any made in the past ten years. It generally happens that about the time that things look most discouraging and hopeless, a turn comes along with these low-priced sales. There has sprung up a demand heavier than has been witnessed for several weeks. Some large orders have been placed, and other larger ones are under negotiations. There is no improvement in price and views differ as to how long the depression can continue. Northern furnaces have improved their position by considerable reduction of freight rates. More life is reported in the Chicago market, both in the way of small orders for immediate requirements, and large orders for future delivery. The past week has seen some very low-priced sales. There is no improvement in prices for early delivery orders, but for long scattered deliveries furnaces are unwilling to accept current figures. Inquiries at St. Louis continue more numerous but no large sales are reported. It is thought that orders of some magnitude will be placed soon, and on the whole, the outlook seems rather better. With such favorable crop prospects and general activity in the different branches of the iron industry, it is surprising that a more active demand for pig iron does not manifest itself. There has been very little change in the Louisville market, save an increased disposition among furnaces to sell iron at present prices for delivery this year. The outlook is considered by many buyers not very encouraging, and it is thought until more furnaces go out of blast, and stocks of iron are reduced, that the market will show but little improvement.

Iron Ore. The talk of the week has mainly been confined to the reduction in the price of high grade Gogebic ores which, until quite recently, had been held firmly at $5.25, but which now have gone down a notch, and during the past week have been offered at $5. The cause for this unexpected drop may in the first place be ascribed to the united action of the consumers who, influenced no doubt and in a certain measure, justified by the exceeding dullness in the pig iron market and the correspondingly low quotations of their finished product, have not seen their way clear to purchase even well known ores of standard quality at what was supposed to be the final price for the season. Some of the dealers, however, are inclined to charge the shrinkage in the price upon certain ores—not leading kinds—which they say were offered at a lower price than $5.25, although guaranteed of the same quality in iron and phosphorus as the ores of established reputation. It is also reported that this second grade ore did not on analysis come up to the guarantee, and that in consequence the buyers were entitled to a reduction which, in turn, affected the prime qualities of Gogebic Bessemers. Upon this basis sales have been made of Aurora, Iron Belt, Brotherton and some others. Whether or not this reduction will affect Ashland and Pence and Hennepin, remains to be seen. For the present, the firms representing these ores say that they will not part with them at less than $5.25, irrespective of other sales, and that if they cannot market their goods at the figure named, they will materially reduce their output. As a matter of fact, and despite the very large sales thus far made—estimated in some quarters at 3,500,000 tons—the chances are that any serious falling off in price at this time will tend toward a reduction in the output all around. It is thought, however, by good judges, that the downward tendency will come to an end with the long hoped-for improvement in the pig iron market, and that a little later on ores of every grade will advance in price.

Pig Iron. Although no transactions are reported that would warrant the announcement of an improved condition in the market, the signs are not wanting that an improvement is a thing of the near future, and that the pig iron industry has about seen its worst days. Large buyers who have hitherto held off, or that have purchased their stocks in the smallest possible quantites from week to week, seem to have reached the conclusion that they will not get their iron any cheaper than at ruling quotations, and in consequence the week has brought forth a great many inquiries, some of them for quite respectable lots. Perhaps one important reason for what seems like the beginning of a buying movement may be found in the refusal of most furnace firms—while disposing of very small quantities of iron at merely nominal figures—to sell either out of stock or for future delivery, round lots at the same low price. If it did nothing else, this action denoted confidence in the ultimate position of the furnace-men, which seems to have contributed no little to a similar degree of confidence in the consumers who are now beginning to inquire for iron in larger quantities to cover their future as well as their immediate wants. The recently published railroad tariffs as to coke appear to be in the nature of a discrimination against this market, and in favor of Pittsburgh and the Mahoning Valley. At this writing steps are being taken to equalize freight rates so as to give the Cleveland market an opportunity to compete on equal terms with other locations.

Merchant Iron. Very little is reported as doing in this market except some large orders lately placed for rails. Bar iron may still be had at 1½ cents, half extra, and sheets are a trifle stronger at old quotations.

Scrap Iron. Little activity is noted in the scrap iron market, although quotations are firm. Two sales of old rails are reported at $21.50. There is no demand for car wheels or railroad scrap. Turnings are held at about $13.

Hardware. A rushing trade in all its branches characterizes the hardware line, and jobbers have no fault to find. Shelf goods as well as heavy hardware are moving rapidly, and the sales were never excelled in volume.

GREAT BRITAIN'S IRON ORE SUPPLIES.

In a recent interesting paper on "The Iron Ore Supplies of the World, with Special Reference to British Requirements," read before the British Iron Trade Association, by its President, Mr. Josiah T. Smith, occurs the following passage regarding "the influence of the United States":

The future of the iron ore supplies of the United Kingdom is also likely to be to some extent affected by the extent to which the United States are likely to come into the markets whence European supplies are obtained. At the present time, the iron works of the United States may be divided, for iron ore purposes, into three great groups, namely: 1. Those on the Atlantic seaboard, such as the works of the Pennsylvania and the Bethlehem iron companies, which draw their supplies largely from abroad. 2. Those in the interior and on the Great Lakes, which are supplied from the Lake Superior and Gogebic ranges. 3. Those in the Southern States, which are supplied from the new fields of Alabama, etc. There are, of course, other furnaces in other localities which depend upon purely local supplies of limited extent, but for practical purposes this arbitrary division will be found to answer every purpose. Obviously, it is with the first group that we are mainly concerned. The works in the neighborhood of New York, Philadelphia and Baltimore, which are built in close contiguity to a port, can draw supplies of ore from Europe almost as cheaply as, if not more cheaply than, the works of Pittsburgh and Chicago, which have to transport Lake Superior ores for a distance varying from 700 to 1,000 miles. If the present duty of 3s. (75 cents) per ton levied on ores imported into the United States were removed, as it is generally expected it will be, European ores could be delivered at United States works at a rate that would compare very favorably indeed with the ores of Lake Superior, the average price of which, delivered at the furnaces, may perhaps be taken at 22s. to 25s. ($4.50 to $5) per ton, while those of Spain at a period of exceptionally low freights ran from 18s. to 20s. ($3.60 to $4), including duty of 75 cents. As against this lower cost of the Spanish ore there is, of course, a set-off in the greater richness of the mineral of Lake Superior, which may be taken as generally containing, say, 8 to 10 per cent. more metal; but the capability of European ores to compete with the native ores of the United States over a large area of consumption may be regarded as proved by the recent importation of a million and a quarter tons in one year, in spite of the 3s. duty.

To which we reply:—

First. There is no general expectation, or even probability, that the present duty of 75 cents per ton will be removed.

Second. The very fact that a million and a quarter tons of foreign ore were imported in a single year, is of itself sufficient reason for the retention of the present duty.

Third. The discovery of new iron deposits is keeping pace with the increasing demands of this country, and the trend of the iron business is Westward and Southward, nearer the natural meeting points of the raw materials. With this shifting of iron centers will, in all probability, come a lessening demand for Spanish ores, and a corresponding increase in the consumption of native ores.

Fourth. We have all the ore in sight and undeveloped, of all grades and qualities, for supplying our iron and steel works for years to come, without calling for a pound of foreign ore. The only thing that has heretofore allowed the importation of Spanish and African ores was the fact that the railroads insisted upon exorbitant charges for carrying our native Bessemer ores to consuming points, especially in the East. This era of excessive freights, happily, appears to be approaching an end, and Eastern furnaces will doubtless ere long be enabled to use Lake Superior ores as freely as they have heretofore used foreign ore. So far, then, as the future requirements of Spanish ores by the United States are concerned, British ironmasters need borrow no trouble, unless all the signs of the times should fail.

MR. HEWITT'S VAGARIES.

Hon. Abram S. Hewitt, of New York, recently interviewed in London, is made to say that the present American tariff is only a temporary matter and that another generation will see it removed. Of course, this sort of talk suits our Free Trade friends, and Mr. Hewitt's opinion is paraded as "a frank declaration on the part of an iron king; one who has the confidence of the American iron-producing world." Mr. Hewitt is a very estimable gentleman and his views have long been known to the "American iron-producing world." It is sufficient to say in this matter, that he speaks—simply for Mr. Hewitt. His course in the past, in reference to tariff legislation, has not been such as to invite the confidence of his associates in the same line of business. There are those who, no doubt, would be willing to characterize his course as selfish. At any rate, such views as above promulgated distinctly do *not* represent the position of friends of American industrial supremacy. No one can object to Mr. Hewitt's airing his own opinions, but we have a right to challenge any position he may assume, or be made to assume, as the spokesman for American iron and steel manufacturers. We trust, therefore, that our newspaper friends across the water will curb their glee and make further inquiry among those who *are* authorized to speak for the American iron and steel trade. A note addressed to Mr. James M. Swank, General Manager of the American Iron and Steel Association, Philadelphia, Pa., might elicit some rather disheartening facts for Free Traders upon this point.

WHERE IS THE STEEL CENTER NOW?

One or two things are very evident from the recent reduction in iron ore freights from Lake Erie ports to Pittsburgh. In the first place, it means a saving of $600,000 a year to Pittsburgh iron and steel manufacturers, if the Pittsburgh *Dispatch's* figures are correct. Here is the way the *Dispatch* figures it out:

It takes one and six-tenths tons of ore to make a ton of pig iron, so a reduction of 20 cents per ton on ore, means a decrease of 32 cents per ton in the cost of manufacturing a ton of pig iron. There were 890,000 tons of pig iron made last year in Allegheny county, and the reduction, or rather the saving, by this freight item alone, would have been $248,000. Then again, in actual practice it requires about one and one-half tons of pig iron, and about 500 pounds of ore, to make one ton of finished iron, so that by this break there is an actual reduction of 56 cents per ton. As for steel rails, the reduction to come in force will make it from 45 to 50 cents per ton, and on blooms it will amount to from 40 to 45 cents. The leading reduction, of course, is in the cost of manufacture; the actual cold, hard cash paid for material, and the effect cannot but be felt. There were over 600,000 tons of finished iron made in this booming Allegheny county last year, and about an equal amount of steel (calculated in rails), while the production of steel, if figured in blooms, would reach over 700,000 tons. Therefore, without any more details in tiresome figuring, these reductions in freights should make a total economy or saving to iron and steel manufacturers of about $600,000 per year.

Then again, it puts Pittsburgh in position to once more meet Southern and Western competition. This, we are to presume, is Pittsburgh's answer to the recent consolidation of steel interests in Illinois. If followed up with a reduction on coke freights, it may mean a lively fight for supremacy, and it may mean this anyhow.

The effect of this cut upon the Ohio iron-producing districts remains to be seen. The Pittsburgh manufacturers demanded a reduction to 90 cents, that being named as the figure upon which alone they could be brought on an equality with the Hocking Valley furnaces. As they got a $1.05 rate, it may be inferred that the Ohio furnaces have a good fighting chance yet. As to Northern Ohio furnaces, strict equity demands that they be given a pro rata reduction on coke. This they have a right to demand, in order to put them on a corresponding basis of competition, and we have no doubt the railroad authorities will see it in that way.

CUBAN ORES AND CUBAN ANNEXATION.

Our friend, the Chicago *Journal of Commerce*, has read the columns of THE IRON TRADE REVIEW with so little care that it states that this journal thinks that the present tariff on iron ore is high enough, in view of the fact that American capital is going into the business of iron mining in Cuba. Of course THE IRON TRADE REVIEW never assumed any such position. It suggested, as one remedy for the competition of foreign ores, the lowering of rail freights from Lake Erie points to Pittsburgh and the East. It did not assume to say that there should be no advance in the tariff to meet these changed conditions. That is a question for the future. What it did say was that, if American capitalists chose to invest their money in Cuba, no one could object so long as they did not seek to lower the tariff in their own interest. That there is no reasonable danger of this is evident from the fact that one of the gentlemen concerned in the new Cuban enterprise was chiefly active, in the face of great odds, in securing the present tariff. That is the whole situation, fairly stated.

Perhaps, however, there may never be any occasion to raise the question of an advance in the tariff. The other day, in the Florida House of Representatives, Mr. Moreno, a Cuban, presented a memorial to Congress, asking that body to open negotiations for the independence of Cuba. In consideration of such independence, Cuba would agree to pay to Spain the sum of $100,000,000, in twenty annual installments of $5,000,000 each, in the meantime putting herself under the protectorate of the United States until all payments were made. May not that be a first step toward the annexation of Cuba to the United States?

A GENUINE and agreeable surprise was given the iron trade of Eastern Ohio and Western Pennsylvania, on Monday, in the announcement, by the New York, Pennsylvania and Ohio Railroad, of an average reduction of 10 per cent. on pig iron freights, and of 20 per cent. on manufactured iron. The new schedule is to take effect May 30 and is to continue until August 31, after which date the present prices will prevail. It is to be hoped this movement will have the designed effect of stimulating the iron business of this region.

WHEN THE WOOD IS GONE, USE BRICK.

BY PROF. J. F. ELSOM.

WRITTEN FOR THE IRON TRADE REVIEW.

There seems to be a very grave question agitating the minds of architects and builders regarding the building material of the future. The timber is being used faster than it can possibly grow; stone occurs only in isolated places and rarely, if ever, contingent to places where needed in great quantities for building purposes, but material for making brick seems to be in abundance everywhere.

Again, the services of this laboratory have been brought into requisition for deciding the relative values of brick as compared to iron, steel and stone as "fire-proofs," particularly for ornamental fronts, pillars and palisades, one case in particular, in the case of a frightful accident, resulting in two deaths and an alarming loss of good property in a collapse occurring a couple of years ago. I have yet to see, and I have been in constant practice nearly twenty years, any material that, all things considered, will withstand the onslaught of extensive fires equal to good brick. The experience in Chicago and Boston proves this conclusively, and, notwithstanding the fact that iron, steel, granite, etc., present a much greater crushing strength than our ordinary brick, it has been shown during great fires that with two buildings in every way equal, so far as exposure to the heat was concerned, one constructed entirely of brick, the other with iron parts, pillars and window casings, the former will stand until completely gutted by the fire before the walls will totter and fall, in many instances not falling at all even after the interior is completely burned away, while the latter will often fall before the flames have reached it, the iron bending, twisting, and otherwise distorting sufficient to allow the superincumbent mass to fall for lack of support, by the heat generated by the fire of an adjoining building, and if of granite or stone, chipping and cracking until like causes produce like disastrous results.

I have been told by old and experienced firemen that during the progress of extensive fires it was usual to allow the men to work around brick buildings—pre-supposing them to have been well made of good brick—as long as they could for the heat, but with buildings wherein iron or steel entered largely into construction, especially as supports, even approaching a burning building was always accompanied with danger from the building collapsing.

Insurance companies also recognize the reasonableness of the theory and efficacy of these conclusions. As a rule, their rates are lower on solid brick than on mixed structures, and accident companies draw deep, dark lines between the two when they write policies covering each loss separately, and insurance experts have long since decided that a building constructed largely or even entirely of iron is not necessarily fire-proof.

Iron, when heated, bends very readily when under light pressure, and cannot be considered of itself fire-proof. I am forced to admit, as the result of experience, that there is very much to be said in favor of iron as a building material. It prevents fire from spreading, and unless there is a large amount of inflammable material in reach of the flames, there is little danger of the fire itself making much direct headway amidst a mass of iron, but I am not speaking of direct burning but the results of the burning of other substances sufficiently near to heat the iron.

Returning to granite and other varieties of stone, any of them are little if any superior to iron, as preventing these indirect results of fire, hence, for these reasons alone, brick stands at the head as a building material. What though brick itself presents a comparatively low crushing strength as compared to iron, steel, etc. (a very silly argument presented sometimes in their favor)? But does not every single brick in a properly constructed wall bear its own weight, and to make them doubly, aye trebly, strong in this respect, are not the joints broken in every conceivable manner as the walls are built?

Brick has passed through many fiery ordeals, and stood apparently unharmed long after iron, steel and the hardest rock have succumbed, burying almost countless millions in its debris, which with brick could have been largely saved. Cast iron is not homogeneous enough, is not solid enough. Wrought iron, though an improvement, is but little better. For a strictly fire-proof building in purpose as well as intent, there is not a material known in chemistry that stands ahead of well-made fire-brick. If great ornamentation is required, why glaze them, and this can be carried to any extent of ornamentation desired by the most æsthetic architect and means of the proprietor.

I do not wish to speak disparagingly of the many processes of fire-proofing after the building is completed; many of these are made from the formulas of the most celebrated chemists, who should be well rewarded for their sweating brains. Many are made and put on the market by men of honor and integrity as well as wealth; all good ones are good, all poor ones are bad, and were I asked an opinion concerning them and their efficacy, I should say get a good one and use, by all means, on valuable buildings, but put not your trust in all of them, hold fast to that which we know is good.

Many say fire-brick are too expensive; so they are if we transport them a thousand miles as many of our builders do; but when, as is generally the case, the materials for the manufacture of fire-brick are in abundance within twenty miles of every brick yard, this argument of price lacks in pertinency. What constitutes the fire-clay used in the construction of melting pots, crucibles, and annealing ovens, though good, is not absolutely necessary for building brick; "60 and 40" will do, and do well, if they are well made and properly passed through the fiery ordeal in their manufacture. If they come out of this all right there is little danger of their succumbing in subsequent fires.

Notable Articles on Electricity.

Scribner's Magazine for June marks the beginning of a new enterprise not less notable than the Railway Series commenced a year ago. It is the series of popular articles on The Practical Applications of Electricity, a subject which has become of chief importance in the scientific, commercial and industrial worlds. The opening article, by Professor C. F. Brackett, of Princeton, is entitled "Electricity in the Service of Man." It is an introductory paper which sets forth, in a clear and precise way, some of the common methods by which the more important electrical phenomena are produced, the laws which they reveal, and the principles involved in measuring electrical quantities such as the Volt, Ampere and Ohm—terms which have lately come into general use, though not popularly understood. The principles so lucidly explained in this article will be fully applied in the rest of the series, which will describe Modern Telegraphy, Electric Lighting, Household Devices, etc. The illustrations in Professor Brackett's paper show some of the best apparatus in a thoroughly equipped modern laboratory, and include a number of rare portraits and several figure-pieces. Among the writers already secured for this series are announced C. L. Buckingham, chief electrical expert of the Western Union, President Henry Morton, of Stevens Institute, Dr. M. Allen Starr, a prominent authority on electricity in medicine, and A. E. Kennelly, chief electrician in Mr. Edison's laboratory. Each paper will be elaborately illustrately from special sketches and photographs, which it has been possible to make through the unusual privileges granted this *Magazine* by the leading electrical companies.

"BIG THINGS" IN MILL AND MACHINE SHOP.

Carnegie, Phipps & Co. have at their Homestead (Pa.) mills the largest universal mill in the world.

At the Edgar Thomson Steel Works, Pittsburgh, week before last 2,256 rails were made in one turn of twelve hours.

The Southwark Foundry & Machine Co., of Philadelphia, is turning out this year some very heavy work. It recently finished four immense duplex blowing engines for the new works of the Pennsylvania Steel Co., near Baltimore. Each engine weighs 755,000 pounds, and under each are two bed-plates weighing 63,000 pounds apiece. These were cast in one piece. The fly-wheel, weighing 100,000 pounds, was also cast whole and split afterwards. It is believed that these are the largest blowing engines in the country.

Although the month of May, 1889, will not go down into history as an unusually prosperous one, from a business standpoint, the Westinghouse Machine Co., of Pittsburgh, report orders received for the first 21 days of the month, as follows:

Westinghouse Automatic Compound Engines	17;	1885 H. P.
Westinghouse Standard Automatic Engines	19;	745 H. P.
Junior Automatic Engines	30;	745 H. P.
Twenty-one days totals,	66;	3375 H. P.

If the remaining 10 days of the month show the same ratio, this will prove to be a very prosperous month in the company's history.

Says the Canton (O.) *Repository* concerning a contract taken in that city: The Wrought Iron Bridge Co., of Canton, has out-classed all competition in bidding on the contract for the construction of the mammoth steel viaduct for the Denver City Cable Railway Co., a company owned by a New York syndicate that is building a cable road in Denver, Colo. The viaduct will be a massive all-steel structure, and will furnish a roadway for cable cars up a long incline and over a valley. All the big steel concerns of the country have been figuring on the job, and the large Eastern manufacturers went so far as to pool their issues in a combination to prevent the Canton company from getting the contract, but in this they failed. To a *Repository* reporter Secretary and Treasurer Frank M. Wyant, of the Wrought Iron Bridge Co., said: "We have been awarded the contract and it is the largest single contract ever taken by us. The viaduct will be 3,028 feet long and forty feet wide, and will require for its building 1,000 tons of steel structural work and over 1,000,000 feet of lumber. It will be the largest single shipment ever sent out of Canton, and will require seventy-five cars to transport it. The contract price is $135,000.

More About Fuel Oil.

The following circular from the Associated Factory Mutuals is of interest to every manufacturer and mill owner.

For some months past petroleum or its products have been offered to members of the Mutual Companies for the generation of steam and for metallurgical purposes. Under this name "crude oil" and what are called "reduced oil" and "residuum" have been offered from different sources in different places under different representations of the fire and flash tests.

The petroleum or its products first offered had such a fire and flash test as to have been deemed by the underwriters safe for use, provided the method of use should be carefully considered and guarded.

After some time had elapsed in which the right method of use had been under consideration it was discovered by the underwriters that "crude oil" had been substituted for the "reduced oil" or "residuum," first put into the tanks for consumption by members or the Mutual Companies.

On testing this crude oil it was found to consist in very considerable part of extremely volatile matter giving off heavy explosive and combustible vapors at less than the freezing point, the advantage claimed being that the crude oil would flow more freely in cold weather than the reduced oil, which may or may not be true. Such an advantage does not compensate for the probable danger which may or must ensue from the introduction of a liquid which will give off fifteen or twenty per cent. of its weight in extremely dangerous heavy vapors at or below sixty to sixty-five degrees Fahrenheit.

Measures are being taken to bring the use of petroleum or its products under safe conditions for generating steam, if it can be done. In the meantime this warning is given in order that the crude petroleum may not be introduced for steam purposes by any member of any Factory Mutual Company without full knowledge of the hazard incurred, or of the effect of incurring this hazard upon outstanding contracts of insurance without the consent of the underwriters.

THE TREATMENT OF STEEL BY HYDRAULIC PRESSURE.

AN interesting paper with the above title was read by Professor W. H. Greenwood, M. I. C. E., of Sheffield, (Eng.) Technical School, at a recent meeting of the Institution of Civil Engineers. The paper opened with a brief description of the various sources of unsoundness in steel ingots as usually cast, which were of three sorts. First, there are the bubbles caused by the evolving of certain occluded gases, chiefly hydrogen and nitrogen, these gases being more or less completely evolved at the moment when the metal changes from the liquid to the solid state. Secondly, after the outer skin has solidified, the further contraction of the metal within the ingot also produces cavities; and, thirdly, the ordinary method of casting results in the development of a radial acicular structure, which is a further source of weakness along the surface of the ingot. By reason of these defects from 40 to 50 per cent. of the ingot requires to be rejected by cutting, turning and machining. Even then the remaining metal is greatly inferior to that produced by fluid compression.

The author next referred to various expedients, both chemical and mechanical, for improving the quality of steel ingots, such as increasing the proportion of manganese and silicon, cooling the outside of the moulds, agitating the metal during solidification, casting in a vacuum, direct application of pressure upon the surface of the fluid steel in closed moulds, &c., but none of them commended themselves and most had failed. The method of fluid compression alone remained in yielding ingots of mild steel practically uniform in molecular structure, strength, and ductility throughout their length.

The plan was originally suggested by Sir Henry Bessemer, but was independently developed, and carried to a successful issue at the works of Sir Joseph Whitworth & Co. The ordinary cast iron moulds, or wrought iron casings, lined with brick or moulding cement, could not be used when aggregate pressures of thousand of tons were to be exerted upon the surface of the fluid metal; but such moulds were replaced, in the fluid-compression process, by built up steel moulds, lined with suitably-grooved cast iron lags, protected by a coating of refractory silicious materials. A loose plate of the diameter of the ingot fitted in the bottom of the mould, and was protected by an upper covering of burnt fire-clay segments, and a similar plate was carried upon the top plunger of the press for closing the top of the mould.

The first hydraulic press was a 250-ton press, erected in 1866. In this the mould, which was partially filled with metal, was carried in a middle head of the press, whereupon a core carried upon the top head of the press, was forced into the fluid metal, at the same time closing the mouth of the mould. After this the pressure was applied from below, as in all subsequent presses. The next advance was a 2,000-ton press. The third, also erected in Manchester, was capable of producing a pressure of 8,000 tons. Following this the author constructed at the Abouchoff Works, St. Petersburg, on the lines of the Whitworth patent, a 10,000-ton press, which Professor Greenwood proceeded to describe in detail. In actual operation the moving head first descended until the top plunger came fairly in contact with the fluid metal. The head, weighing 50 tons, would continue to descend for a few seconds, after which it was locked in position, and the compression completed by admitting the water direct from the pumps to the large pressing cylinders. During the first few minutes the ingot shortened rapidly, and a considerable volume of gases escaped and burned from the vents around the top and bottom of the mould. The pressing was continued as long as there was any perceptible shortening. The maximum pressure attained ranged from 4 to 12 tons per square inch on the metal, and were maintained for from 45 minutes to three or four hours, according to the size of ingot and the condition of the metal. The contraction in length during the application of the pressure usually amounted to about 1½ inch to the foot of length.

The concluding portion of the paper described the various tests to which the author had subjected the pressed and unpressed ingots to compare their elastic limit, ultimate breaking strength, contraction in area at point of fracture and elongation, and he inferred from the results that under mechanical tests the metal from the top, or any other vertical section, of a pressed ingot was, at least, equal to the unpressed ingot after one-third or upwards had been cut off or rejected; that the weakest part of the pressed ingot was along the axis, where the pressure had been least effective; but that this weakness, as compared with the outer layers, arose from insufficient pressure, and could be localized; so that, for hollow shafts, tubes, hoops, cylinders and the like, where the centre was finally removed, either by boring or punching out, it was unnecessary to proceed to the higher pressures required to ensure absolute solidity and uniformity over all parts of any section. With unpressed ingots, on the other hand, the unsoundness was irregularly distributed, and not capable of such localization, even in the lower end of the ingot.

High Pressure Boilers.

The fear of high boiler pressures that existed only a few years since in the minds not only of the public but also of many engineers, is rapidly disappearing before the results of modern practice; and it is furthermore asserted that the statistics of boiler explosions in England and France prove that the low pressure boiler explosions have been the more frequent and the more disastrous. Several reasons have been given for this, but the following would seem to be the most conclusive: The law requires that every new boiler and every old one, after it has undergone extensive repairs, shall not be sent out of the shop or be put into service until it has been tested to double the effective pressure under which it will be worked. A heavy boiler which is to work with a pressure of 120 pounds to the inch must be able to carry from 240 to 300 pounds pressure, which corresponds to a temperature of from 397 to 416 degrees F. These are conditions that will rarely be attained, even with the most careless attendance; while it is comparatively easy to rupture a low pressure boiler, since the test pressure may not exceed 45 pounds or 60 pounds of the most, and this corresponds to a temperature of from 274 to 292 degrees F., these pressures being regarded as the absolute above the vacuum, as that is the basis upon which the foreign boilers are tested. It will readily be seen that the latter temperatures are readily reached, even with slow fires.

Furthermore, high pressure boilers require more perfect construction, on account of the very weakness that they have a tendency to develop. The sheets in contact with the water and steam radiate an amount of heat that is quite intolerable to the attendants, and they must, therefore, be covered with non-conducting materials and air spaces, and this involves constant care and attention. Their advantage is so apparent, from the success attending their use, that the whole tendency of modern steam engine practice is toward higher pressures and the use of engines with a high rate of expansion, whether they are used with or without a condenser.—[Safety-Valve.

Recent Blast Furnace Records.

The Neshannock Furnace, New Castle Pa., made 210 tons of No. 1 Bessemer iron on the 15th inst.

Soho Furnace, of the Moorehead McCleane Co., Pittsburgh, Pa., produced 5,520 gross tons of pig iron during the month of April.

The two blast furnaces of Schoenberger, Speer & Co., of Pittsburg, Pa., produced 5,354 gross tons of Bessemer pig iron during the month of April last.

The blast furnace of the Bellaire Nail Work, at Bellaire, O., has now been in blast for two years and seven months on its present lining, and during that time has made 123,000 tons of pig iron, 95 per cent. of which was No. 1 Bessemer. From present appearances the furnace will continue in blast for some months to come.

The new Carrie furnace, at Rankin Station, near Pittsburgh, Pa., is ready to be put in blast, but the new furnace of the Eliza Furnace Co., will not be ready much before July 1st. The last new furnace built by this company has just been blown out for the first time. It was in blast since June, 1887, and in that time made 135, 000 tons of pig iron.

Lucy Furnace No. 1 has just been blown out, after having been in blast 2 years 10 months 14 days. In that time it has cast 192,000 tons. The lining has all been removed, and a force of men are now engaged in blasting and removing the salamander, which is a mass of about 60 tons at the bottom of the furnace. In another week work on relining will be commenced. Other repairs are to be made in the engine house and to the hot-blast stoves, which will take until about the middle of July.—[Pittsburgh Dispatch.

The Pioneer charcoal furnace of the Iron Cliff Co., at Negaunee, Mich., has been doing remarkably good work. The furnace has made thus far on this blast 52,000 tons of pig iron, and during the last month it averaged over 80 tons daily. The highest product for any one day was 89 tons, which was accomplished on the 30th of April. As the dimensions of this furnace are but 57 feet by 10 feet, it is claimed that this is the best record for a charcoal furnace up to this time. The large output is certainly very creditable to the management, and sustains the reputations which charcoal furnace-men are now making for progressiveness.—[Iron Age.

Large Order for Mining Machinery.

An extensive order received from "Ashland" mine in the Gogebic Range, in the ore regions of the Northwest, has just been filled by the Webster, Camp & Lane Machine Co., of this city, says the Akron (O.) *Beacon*. The order called for three hoisting drums, each 10 feet in diameter with a capacity of 1,500 feet of cable and weighing over 100 tons; an automatic engine, of 300 horse-power, a complete plant of boilers with stack and fixtures, also "skids," "sheaves" and wire rope, all of which are to be used in connection with the hoisting machinery. The same order also included three hoisting drums, each 10 feet in diameter, 1,500 feet of cable and a 300-horse power automatic engine for the "Germania" mine. The firm has also recently turned out two engines for the Union Strawboard Co., at Anderson, Ind. The engines are each 300 horse-power with cylinders 26x48 inches in size, and both propel an enormous belt wheel 20 feet in diameter, weighing 25 tons. This wheel is the largest ever turned out in this section, and is made in two parts which are boelted together, making a belt surface of six feet in width. The trade of this company is daily increasing, as the firm is building up a large custom in the mining districts all over the country.

Steel-making in the South.

The South is apparently about to begin in earnest to manufacture steel. Two projects in this line are about to be started. The Henderson Steel & Manufacturing Co., of Birmingham, Ala., which successfully made open-hearth steel with an experimental plant in 1888, has increased its capital stock $60,000. On the 18th inst. a committee was appointed to receive propositions for the location of a permanent plant. As soon as a site is selected the company proposes to build an open-hearth plant of 50 tons' daily capacity. The company expects to have contracts awarded by the 27th inst. for the construction of its plant. The other steel plant is projected at Fort Payne, De Kalb county, Ala., in connection with the furnaces and rolling mill which are to be built there. Mr. George Gogin, of Boston, a practical steel furnace builder of twenty years' experience, has gone to Fort Payne with plans for a plant of two open-hearth furnaces of large capacity.—[Bulletin.

THE machinery necessary for the transportation of people to the top of the Eiffel Tower, at Paris, and the pump to furnish water to the Exposition buildings are of American design. Worthington pumps furnish the hydraulic pressure for the Edoux elevators.

FROM the Mahoning and Shenango valleys the rate on cotton ties to East St. Louis has been reduced to 12½ cents in car-loads lots. To Cairo the rate has been reduced to 15 cents in car lots. The new rate went into effect on the 10th inst.

INDUSTRIAL SUMMARY.

New Enterprises :—

IRON AND STEEL.

The Portsmouth Stove & Range Co. has been incorporated with a capital stock of $50,000.

The Stewart Boiler Works, Worcester, Mass., will build a factory south of East Worcester street. They have purchased 63,000 feet of land.

The Union Drawn Steel Co., of Beaver Falls, Pa., has been incorporated with a capital stock of $100,000.

A rolling mill to cost $100,000, and to have a capacity of 50 to 75 tons of bar iron per day, is to be established at Iron Gate, Va. It is expected that this will be followed by a nail factory and other enterprises.

The Southern Stove Works Co. has been chartered at Richmond, with C. H. Fleming, president; W. J. Loth, vice-president, and Percy Loth, secretary, to carry on a general stove and foundry business. The capital is to be not less than $20,000 nor more than $200,000.

The Monongahela Blast Furnace Co. was permanently organized at McKeesport, Pa., on the 16th. The corporation is composed of the stockholders of the National Tube Works Co., and propose to erect two of the latest improved furnaces, each with a capacity of 250 tons daily, on the site of the White homestead. The pig iron made will be used in the Tube Works and the Republic Iron Works, of Pittsburgh. Committees will be appointed at once to secure bids for the building of the new plant, which the company hopes to have completed by February 1, 1890.

It is reported that the New York & Nova Scotia Iron & Railway Co. proposes erecting two furnaces at New Glasgow, Canada, one for Bessemer and one for pig iron, one of which will have a capacity of 25,000 tons per annum, employing several hundred men in mining the required 50,000 tons of ore, 50,000 tons of coal, and 50,000 tons of limestone. A staff of ten engineers has been surveying the railway routes from the mines to New Glasgow and the Intercolonial Railway since December, and the citizens have offered 100 acres within the town limits to any company working the mines.

MACHINERY.

Elmer Apperson is erecting a machine shop at Kokomo, Ind.

At Grafton, W. Va., the Baltimore & Ohio Railroad Co. are erecting car and repair shops, where they will employ 200 men.

The Newport News & Mississippi Valley Railroad Co. have bought 1,600 acres of land at Clifton Forge, Va., and it is said will build large machine shops.

Incorporated: Colby Electrical Manufacturing Co., Chicago; capital, $100,000; to manufacture electrical goods; incorporators, E. J. Colby, H. J. Hayes and F. W. Parker.

Repair shops and round-houses will be erected near Grantville, Conn., by the Poughkeepsie Bridge Co.; 400 acres of land having been secured for the purpose.

At Madison, Wis., the following companies have filed articles of incorporation: The Sheboygan Electric Light Co., capital $25,000; incorporators, A. F. Luberman, W. D. Crocker and others.—The Milwaukee Equipment Co., for the manufacture of machinery; capital, $2,000,000; incorporators, H. H. Stofford, A. B. Meyers and H. L. West.

Enlargements, Additions, etc.:—

Jno. E. Randle & Co. are building an addition to their machine shop, at Memphis, Tenn.

The Damon Safe & Wire Works are making extensive additions to their works at Cambridge, Mass.

Extensive improvements are contemplated by the Birmingham (Ala.) Foundry & Machine Co.

The Simmonds Rolling Machine Co., of Fitchburgh, Mass., has increased its capital stock from $400,000 to $600,000.

A building for the construction of steel railway cars is being erected by the St. Joseph Steel Car Co., at St. Joseph, Mo.

Andrews Bros. & Co., of Hazelton O., are adding a new and improved hot blast stove to their furnace, which will cost about $50,000.

The Rockford Bit Co. is preparing to expend $15,000 this Summer in building additions to the already extensive works at Kokomo, Ind.

A new factory will soon be erected at Shelton, Conn., by the Excelsior Mfg. Co., makers of edge tools. It will be 40x280 feet. Three stories high.

The galvanizing works of Wilcox, Crittenden & Co., at Middletown, Conn., are to be enlarged. The present one fails to be sufficient to do the work for their increasing trade.

At Allentown, Pa., the Iowa Barb Wire Works will erect a plant to make their own rods from American steel billets. The rods have been heretofore imported from Germany.

The Henderson Steel & Manufacturing Co., of Birmingham, Ala., have decided at a recent special meeting to increase the capital, and build a 12-ton basic open-hearth furnace.

The Valley Iron Works, of Williamsport, Pa., want to remove their works to a Southern point and organize a $200,000 stock company for the manufacture of engines, boilers and wood-working machinery, they to take $150,000 of the stock and the rest to be subscribed by the citizens of the point where located.

It is reported that the ax factory recently destroyed by fire in Lawrenceville, Pa., will not be entirely rebuilt at Beaver Falls. As the story goes the firm has secured the old Citizens Oil Refinery building, in the Eighteenth ward near the Sharpsburg bridge, and will remodel it for a part of their ax works.—[American Manufacturer, Pittsburgh.

The Schultz Belting Co., St. Louis, have contracted for the reconstruction of a part of their buildings, including an extension to cover a portion of their yard space. The new addition is intended to be 82x53 feet, two stories, exclusive of a deep basement, and will afford them room for quite an enlargement of belt-making facilities.

The Westinghouse Machine Co., of Pittsburgh, Pa., is fitting up a new machine shop, for large work, on the East side of Twenty-fifth St. and Liberty Ave. A very large new planer, by William Sellers & Co., is already erected and in operation, and a large new cylinder boring machine, of special design, by the Pond Machine Tool Co., is now in process of construction, with the delivery promised for June 1st. Other large tools will be added. The new shop is rendered necessary by the company's heavy run of orders for large compound engines.

Fires and Accidents :—

Mr. Richard Brown yesterday at noon received a message from Burlington, Ia., which stated that the Iowa Rolling Mill at that place had burned to the ground. This mill was purchased by Mr. Brown, Mr. E. M. Wilson and Mr. M. C. Williams, with a party at Burlington, about two years ago, the amount paid for it being $70,000, of which the Youngstown capitalists were interested for about one-half. It was considered to be one of the best rolling mills in the West, and has been running steady and prosperous since purchased by the above parties. It was managed by M. C. Williams, formerly of Haselton. The loss is total, and the insurance, as far as could be estimated here, will not cover $20,000 of the loss. The plant was mostly operated by workmen from this city and vicinity. No further particulars could be obtained as to the origin of the fire.—[Youngstown (O.) Telegram, May 26.

Failures, Shut-downs and Wage Matters :—

Notices of reduction of wages to take effect on June 1 have been posted at the Mabel, Sherman and Douglass furnaces in Sharpsville. The rate of reduction is as follows: Laborers, from $1.35 to $1.25; keepers, from $1.90 to $1.75; fillers and all turn men, from $1.75 to $1.50. The reduction affects 400 men.

More furnaces are going out of blast on account of the dullness in the iron trade. The Warren furnace at Hackettstown, N. J.; the Musconetcong furnace, at Stanhope, N. J.; one of the Powelton furnaces, at Saxton, Pa., and the Kemble furnace, at Riddlesburgh, Pa., are among the number.

Works Starting Up:—

Joanna Furnace, in Berks county, Pa., has started up after over two years' idleness. The furnace has undergone extensive repairs, enlarging its capacity, with new engines and boilers, making it one of the finest charcoal furnaces in the State.

General Industrial Notes :—

The merits of the Hartman Manufacturing Co's steel picket fences and gates and their new flexible steel wire mats are admirably set forth in a new catalogue, just out.

W. J. Burton & Co., successors to the Detroit Metallic Shingle Co., Detroit, Mich., manufacturers of the "Eastlake" metallic shingle, have a good supply of orders on hand, and will soon increase their facilities or run nights.

A well-printed catalogue, sent out by John Adt & Son, New Haven, Conn.' manufacturers of machinery for wire-workers and hardware dealers, announces a reduction in price, and calls attention to various improvements made in their machines since the last catalogue was issued.

Sealed proposals will be received at the Office of the Supervising Architect, Treasury Department, Washington, D. C., until 2 o'clock P. M. on the 13th day of June, 1889, for furnishing and putting in place complete in the U. S. Court House and Postoffice at Des Moines, Ia., two hydraulic passenger elevators.

Sealed proposals will be received at the Office of the Supervising Architect, Treasury Department, Washington, D. C., until 2 P. M. on the 13th day of June, 1889, for furnishing and putting in place complete four new steam boilers, and removing five old ones now in the U. S. Postoffice & Sub-Treasury building, Boston, Mass.

Messrs. Isaac McHose & Sons, of Norristown, Pa., have placed the sale of their entire output of special low-phosphorus "Acme" pig iron in the hands of Messrs. Naylor & Co., 99 John street, New York. The "Acme" pig iron is guaranteed to contain; phosphorus, not exceeding .03 per cent.; sulphur, not exceeding .03 per cent.; silicon, 1 to 2 per cent.

Steel Plants for the Bookwalter Process.

The Bookwalter or Robert process for the manufacture of steel is likely to be very thoroughly tested in the West this year. The Michigan Steel Co., of Detroit, are rapidly pushing work on their plant, which they hope to have in operation early in June. The machinery is being built by the Morgan Engineering Co., of Alliance, O. The steel to be turned out by these works will be of a special quality for springs to be manufactured by the Detroit Steel & Spring Works. At Chicago the Fowler Steel Car Wheel Co. have their buildings erected for the steel works, and will be prepared at an early day to put in the machinery, which they expect to start up in July. Their plant will make steel castings in the form of wheel blanks for their rolling machine. Another steel plant on this system is projected near Chicago, but negotiations with the owners of the patents have not yet been completed. If this plant is built it will make a dead soft steel to take the place of highly refined iron in the manufacture of a specialty. A peculiar characteristic of the Robert steel, which was noted by a very practical engineer, who spent some time in investigating the process at Springfield, O., is the difference of hardness between it and open-hearth steel. He states, for instance, that 0.15 carbon Robert steel is as hard as 0.25 carbon open-hearth steel. This is a more decided difference than that which has been found to exist between open-hearth and Bessemer steel, less carbon contents being required in the former to equal that of the latter.—[American Manufacturer.

AMONG THE IRON MINES.

Gogebic Range:—

The Norrie is sending out about 200 cars per day. It is said that the managers of this mine have "set their stakes" for an output of 500,000 tons during 1889, and it is believed there will be little trouble in reaching the figures unless some unexpected delay occurs. The Norrie is the king of Lake Superior iron mines and no mistake.—[Gogebic Iron Tribune. Five hundred thousand tons is a lot of ore, and if the Norrie ships that much this season, possibly we shall have to concede to that mine the first place, to which it is not entitled at the present time. The latest shipping report shows that on the 15th of this month the Norrie had shipped 59,692 tons and the Chapin—the king—had shipped 70,419 tons.—[Menominee Range.

Menominee Range:—

The ore dock at Gladstone, taking the Delta for authority, is now ready for business, and ore shipments can be made to that port via the M. & N. and M., S. Ste. M. & A. roads.

The differences between the Messrs. MacKinnon, owners of the fee of the land formerly operated by the Nanaimo Mining Co., and that company, are in a fair way of being settled by the surrender of the lease. When that is done it will not be long before a new company will take hold of the mine and start it up.—[Reporter.

In regard to the absurd report that the matter of consolidating the Ludington and Hamilton mines was being contemplated, we are authorized to say that it is wholly without foundation. The subject was broached at one time and the conversation had by the owners of the two properties could hardly be called preliminary to negotiations toward that end. At the present time there is not the slightest prospect of a consolidation, and in fact there never has been. There have been negotiations with the view of opening a drift from the Hamilton shaft to A shaft of the Ludington, but the parties could not agree as to conditions and there is no prospect of this even being done. Information received from "trusted officials" is sometimes very untrustworthy.

The mines of the Penn Iron Co. are all shipping vigorously, and, with the exception of Central Vulcan, which must stop as soon as its stockpile is exhausted, all will continue to do so until the close of navigation. The shaft being put down on the north vein at the southeast Vulcan, is now down about 100 feet, and the ore body is six feet wide at this point and is first-class in quality. There is every prospect of a valuable deposit being opened up on this vein, as it has steadily increased in width as the shaft has gone down.—[Current.

Ore has just been struck in a drift north of No. 2 shaft at the Braastad mines. This shaft is located at a considerable distance south of the main workings, a diorite hill intervening. The shaft has been sunk to a depth of 120 feet and it was from the bottom of this that the drift was run. Ore has also been cut in No. 4 shaft and shows a dip to the south, which is valuable for the property's future if it continues to hold its present course. The mine is producing about 550 tons per day, and is in excellent condition.—[Iron Ore, Ishpeming.

Vermilion Range:—

The Minnesota mine is shipping about 4,000 tons daily. Up to last night the shipments amounted to about 90,000 tons. By the close of the week, the amount will exceed 100,000. The Chandler Iron Co., at Ely, are shipping about 2,000 tons daily. There is not much blowing going on at either mine, but a heap of good grade ore is finding its way to a market that will need Vermilion ore when it needs any.—[Iron Journal.

The Vermilion range has more iron companies credited to its history than any iron district in America, probably, not even excepting the Gogebic. While its vast extent and its wonderful richness partially warrants such a result, there is a great majority of the companies, at present at least, on a non-workable basis, a number exceeding the Gogebic which has suffered and will suffer for years from the curse of over booms and stock speculation. "As yet there has been little, if any, speculation in Vermilion stocks, and there is but one good reason for believing there will be," said a well-known mining man this morning, "and that reason is this very fact of a superabundance of companies organized ostensibly as mining corporations. This evidently means an effort to boom the range, something all honest and actual mining men deprecate. We fear any booms in mining stock, for the only result would be just what it has been on the Gogebic, a destroying of confidence in all properties, even the best, and a consequent lack of capital. We have the best iron range in the world, and we need no false booms." A full list of Vermilion companies can hardly be obtained except by searching the records of half a dozen States. The following is, however, practically complete: Minnesota Iron, Minnesota Exploration, Minnesota Capital, Michigan Iron, Michigan Mining, Michigan Mining Development, St. Louis Land Pool, Vermilion Pine, Iron and Land, Vermilion Iron, Consolidated Vermilion, Northwestern, Inter-Ocean, Clingstone, Garden Lake, Chandler, Pioneer, Zenith, James Exploration, Gold River, Hematite, Home, Hall, Harvey, Sixty-Three-Twelve, Longyear-Messaba, Norman, Section 12, North Star Land, Sheridan, North Superior, Hall, St. Louis, Sharp, Nicollet, McComber, Brookfield, Montauck, Lonstorf, Joliet, Syndicate, Iron Ore, Hartman-Hallet, Minneapolis, Delaware, Norman, Fardea, Mesaba, Grand Marais, Union, Fayal, Canton, Bishop, Champion, Chippewa, Vermilion and Grand Marais, White Iron and Lake, Kaninistiqua, Milwaukee, Central, Sage-Emory, Swan, Red Rock, Equator, Hennepin, Long Lake, Bessemer, Northwestern, Cardwall, Silver Lake, Omega, Albany and Chapin-Andrews. Of all these companies only about ten are working, as follows: The two Minnesotas, Pioneer, Zenith, Garden, Lake, McComber, Lonstorf, Consolidated Vermilion, and, perhaps, one or two others.—Duluth Herald.

Bessemer Ores in Texas:—

Verily, Texas' long expected boom is on, and on with a force that is irresistible. The tremendous momentum given to industrial progress in the State by Mr. Rice's New England party's investments and projected enterprises at Denison is being accelerated by other workers in the same direction. Col. Henry Exall, the foremost man of Dallas, and a man who enjoys as much prestige for the successful carrying out of all his undertakings as any in Texas, states in a letter to the editor of the *Manufacturers' Record* that he is now in New York for the purpose of interesting capital in the development of the properties of the Llano Improvement & Furnace Co., whose Bessemer ores will prove a powerful factor in making Denison a manufacturing metropolis. Analyses show these ores to run from 65 to 70 per cent. metallic iron, with phosphorus as low as from .001 to .01 per cent. Their development on a large scale by the Llano Improvement & Furnace Co. will mark a new era in the industrial history, not of Texas only, but, of the entire country, for the reports of the highest authorities indicate that Llano will soon take rank with the Lake Superior region for the production of Bessemer ores. Mr. Geo. M. Wakefield, of Milwaukee, who has been closely identified with the Bessemer ore developments of the Lake Superior region, wrote to the *Manufacturers' Record* a year or more ago a few lines telling of the discovery of this remarkable Bessemer ore field and its extent. Mr. Wakefield predicts that with three years of mining this territory will produce, without trouble, 4,000,000 tons per year. Its development means that Texas is to become an important iron and steel producer, and plans are even now on foot looking to the early investment of some millions of dollars in several great enterprises, backed by some of the foremost business men of the country. Analyses of these ores, made by Carnegie Bros. & Co., show the following results:

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
Silica	2.950	3.050	0.950	1.850	6.750
Iron	68.100	67.250	68.900	67.650	64.400
Phosphorus	0.021	0.011	0.007	0.065	0.083

The North Chicago Rolling Mills and Mr. Davenport Fisher made analyses of many other samples, and a few of them we give:

Iron.	Silica.	Phosphorus.
71.15	.25	.008
71.27	.24	.018
70.16	.19	.001
65.97	3.04	.001

—[Manufacturers' Record.

Lake Superior Shipments of Iron Ore:—

Shipments of iron ore from the mines of Lake Superior for the season of 1889, up to Wednesday, May 22d, are as shown by the appended statement, condensed from the Marquette *Mining Journal:*

MARQUETTE RANGE.

American	2,936	Humboldt	1,632	Queen	5,952
Barnum	918	Jackson	13,416	Republic	58,863
Braastad	9,694	Jackson, pit 7	1,366	Republic Reduction Co.	6,081
Buffalo	5,851	Lake Superior	3,399	Salisbury	1,811
Buffalo, South	2,205	Lillie	6,100	Salisbury Bessemer	3,229
Cambria	13,930	Lucy	1,309	South Buffalo	6,701
Champion	39,913	Marquette	6,124	Superior	10,990
Cleveland	24,748	Michigamme	4,281	Superior, Hematite	10,882
Cleveland, Hematite	8,807	Milwaukee	5,980	Volunteer	2,670
Cliffs shaft	22,571	Negaunee	13,660	Webster	117
Curry	1,687	North Champion	1,118	Winthrop	11,715
East New York	1,364	Pitts. & L. Angeline	33,300		
Hall	8,603	Prout	1,237		
Total, Marquette Range					355,004

MENOMINEE RANGE.

Armenia	4,117	Florence	27,968	Millie	1,272
Chapin	87,874	Great Western	4,729	Monitor	1,301
Commonwealth	16,802	Hamilton	2,921	Norway	16,581
Crescent	4,604	Iron River	22,212	Paint River	1,643
Cyclops	6,841	Ludington	13,585	Perkins	1,222
Dunn	20,113	Mastodon	8,356	Vulcan	32,257
Total, Menominee Range					274,398

GOGEBIC RANGE.

Anvil	3,566	Cary West	631	Pabst	15,371
Ashland	24,965	Germania	10,184	Pence	9,822
Aurora	25,397	Iron Belt	7,478	Section 33 south	4,416
Beaver	4,607	Iron King	7,841	Sellwood Colby	1,584
Brotherton	10,262	Norrie	76,232	South Colby	8,367
Cary	1,615	North Montreal	5,760	Windsor	4,127
Total, Gogebic Range					221,852
Grand Total					851,254

Fast Steaming on the Lakes.

Contemporaneous with the fast steaming on the Atlantic of the new twin propeller, City of Paris, who has lowered the record of time to less than six days, we may mention the fast time made by the Union Steamboat Co.'s steamers Owego and Chemung. The passage made by the Owego of 58 hours from Buffalo to Chicago, beat everything on record up to date, and now her sister ship and the latest addition to the splendid fleet, beats her fastest passage by four hours. The Chemung, therefore, carries the pennant, as the speediest steamer on the chain of lakes, and it is questionable if her record will be broken for some time to come. Possibly the Owego may in some one of her future passages close up to her time, but to surpass the 54-hour record of the Chemung, seems very improbable, although both boats are essentially the same, and were duplicated by the Union Drydock Co., Buffalo, N. Y., in 1887 and 1888.

The present greyhound of the lakes is certainly the Chemung. She was built only last year, with a net tonnage of 1,943, and valued at about $280,000. She rates $5,000 higher, and is three tons larger than the Owego, and from the evidence up to date the slight increased cost is more than met by her extra speed. The amicable rivalry in speed now existing between these two magnificent steamers may do more toward developing the highest power of marine engines than a decade would have brought around in the ordinary course of events, and every one interested in the welfare of lake navigation may refer with pride to the recent performance of the propeller Chemung.—[Marine Record.

SAN FRANCISCO'S is the biggest ship-yard in the country, having a water frontage of 1,080 feet by 1,400 deep, being as large as the Cramp and Roach yards together. Our first all-steel vessel was made there.

AMERICAN MACHINERY FOR EXPORT.

Havana Introduces the Mechanical Glow-worm.

The Spanish-American Light & Power Co., of Havana, Cuba, have completed their new plant, which is now in very successful operation. The power consists of one 13 and 22x13 (125 H. P.), and one 10 and 18x10 (65 H. P.) Westinghouse automatic compound engines.

Compound Engines for Spain.

The great "Tarzuela" at Madrid, Spain, which is the largest theatre in the kingdom, has recently introduced a complete installation of electric lighting, under the supervision of Mr. L. Delannov, mechanical engineer, of Barcelona; a 12 and 20x12 Westinghouse automatic compound engine, built at Pittsburgh, being used as the motor.

American and European Articles of Manufacture.

We gather from an editorial in the *Mexican Financier* that a controversy is proceeding in business circles in Mexico as to the relative merits of American and European articles of manufacture. One of the native papers issued in the city of Mexico has been counseling the people to buy as few articles of American production as possible, giving, whenever they can, the preference to European wares. This advice, the *Financier* says, will not be followed, for the reason that foreign goods are bought solely on business principles; that is, the purchase is made solely because of cheapness, quality, and facility of importation. American exports, proceeds our contemporary, to this country are increasing for several very good reasons. In the first place, the railways permit of the prompt delivery of goods ordered; in the second place, the prices are often lower than for the similar articles made across the Atlantic; and then again the quality is not infrequently superior. Another reason why more and more American goods are sent here every year is that the Americans buy more extensively of Mexican productions than any other nation, and thus a current of trade exchanges is naturally established. Those who object to American tariff aver, with a cynical disregard of facts, that European goods are invariably superior to those of American manufacture, but the matter may be safely left to the decision of the Mexican people, who are not fools, but, on the contrary, are very quick to discern the merits of any article offered them. The day has gone by when the rubbish of European markets, from unsalable hardware to damaged cloths, can be dumped here. In past years the people of this country were shamefully imposed upon in many classes of goods, having, at that time, no means of comparing similar goods of different origin. And all this is not saying that in many articles European manufacturers do not excel; the Americans themselves import heavily of English, French, and Belgian wares, and, on the other hand, American machinery, cutlery, watches, &c., are found on sale throughout Europe. The true trade policy for Mexico is to buy in any quarter of the globe where it can trade most advantageously, and, as business is not transacted on sentimental principles, it is entirely probable that the foreign purchases of this nation will continue to be effected with the purpose of getting the best that can be obtained for the money offered.—[English Exchange.

NEW IRON FREIGHT RATES.

The Southern Railway and Steamship Association have issued a circular on pig iron rates, to take effect on June 1. To the principal points the figures are as follows:

To	From Birmingham, Ala.	From Chattanooga, Tenn.	From Sheffield and Florence, Ala.
Akron, O.	$4.00	$3.50	$3.75
Allegheny, Pa.	4.65	4.15	4.40
Atchison, Kan.	5.49	5.49	5.04
Bellaire, O.	4.65	4.15	4.40
Belleville, Ill.	3.25	3.00	2.80
Bridgeport, O.	4.65	4.15	4.40
Cairo, Ill.	2.75	2.50	2.50
Chicago, Ill.	4.00	3.75	3.75
Cincinnati, O.	2.75	2.25	2.50
Cleveland, O.	4.00	3.50	3.75
Columbus, O.	3.50	3.00	3.25
Dayton, O.	3.50	3.00	3.25
Detroit, Mich.	4.00	3.75	3.75
East Saginaw, Mich	4.50	4.25	4.25
East St. Louis, Ill.	3.25	3.00	2.80
Evansville, Ind.	2.75	2.50	2.50
Fort Wayne, Ind.	3.75	3.50	3.50
Greencastle, Ind.	3.75	3.50	3.30
Indianapolis, Ind.	3.25	3.00	3.00
Kansas City, Mo.	5.49	5.49	5.04
Lafayette, Ind.	3.75	3.50	3.50
Leavenworth, Kan.	5.49	5.49	5.04
Lima, O.	3.75	3.25	3.50
Louisville, Ky.	2.50	2.25	2.25
Mansfield, O.	4.00	3.50	3.75
Memphis, Tenn.	2.00	2.00	1.55
New Albany, Ind.	2.75	2.50	2.50
Newark, O.	3.90	3.40	3.65
Peoria, Ill.	4.00	3.75	3.75
Pittsburgh, Pa.	4.65	4.15	4.40
Pullman, Ill.	4.00	3.75	3.75
Sandusky, O.	4.20	3.70	3.95
South Bend, Ind.	4.00	3.75	3.75
Springfield, O.	3.50	3.00	3.25
Steubenville, O.	4.65	4.15	4.40
St. Joseph, Mo.	5.49	5.49	5.04
St. Louis, Mo.	3.25	3.00	2.80
Terre Haute, Ind.	3.25	3.00	3.00
Toledo, O.	4.00	3.50	3.75
Wheeling, W. Va.	4.65	4.15	4.40
Zanesville, O.	4.00	3.50	3.75

Following is the official schedule of freight rates from Lake Erie points on iron ore, taking effect May 28:

	Old rate.	New rate.
Pittsburgh, Allegheny, Chartiers, Beaver Falls, Sharpsburg, Rankin, Bessemer, Munhall, Cochran, Demmler, McKeesport	$1.25	$1.05
Sharpsville, Sharon, New Castle	.72½	.62½
Struthers, Youngstown, Girard, Haselton, Lowellville, Niles	.72½	.62½
Johnstown, Conemaugh, Dunbar, Scottsdale, Everson, Oliphant, Uniontown, Fairchance	1.60	1.34
Leechburg, Apollo	1.35	1.22
*Kittanning	1.40	1.40

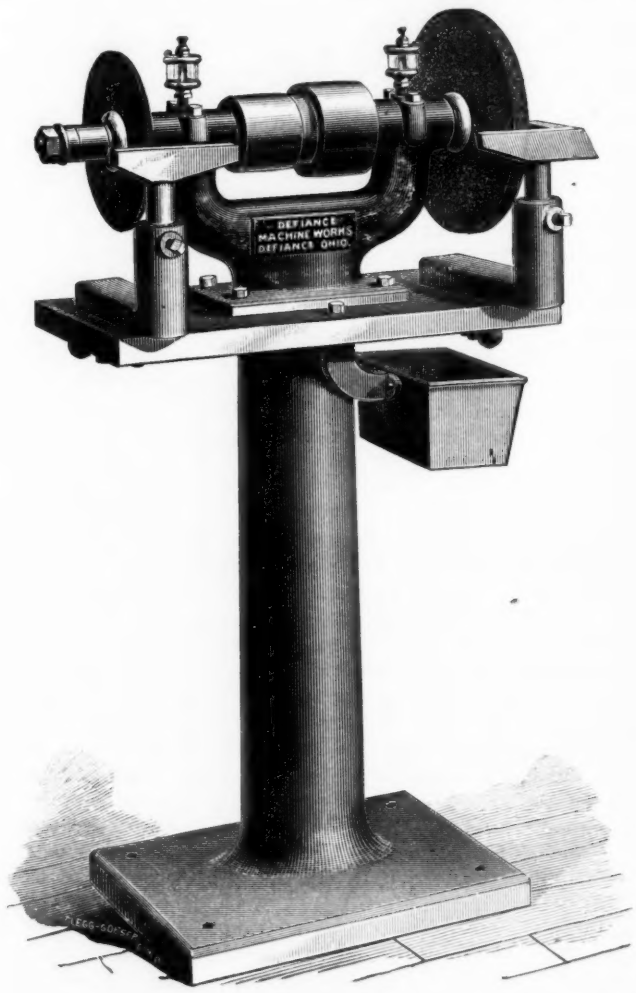
These rates take effect on the lines controlled by the Pennsylvania Co., the Baltimore & Ohio Railroad, the Pittsburgh & Western Railroad, the New York, Pennsylvania & Ohio Railroad, and the Lake Shore & Michigan Southern Railroad.

Concerning the freight situation in the East, the Philadelphia *Record* says: Iron dealers are expecting that the railroad companies when they shall reduce the tolls on coke, as seems likely, will also lower the rates on manufactured iron. A considerable amount of the pig iron manufactured in Eastern Pennsylvania, especially that for foundry purposes, is shipped to New England from Philadelphia and New York. It is the rate from the furnace to these ports which will stand reduction. It is claimed that in order to give iron manufacturers all the advantages possible the railroads must not only carry the raw furnace materials at a reasonable rate, but must also carry the product to its market cheaply. The rate on pig iron averages more than 1 cent per ton a mile. Concessions have just been made to the iron men of Pittsburgh by a 15 per cent. reduction in the rate on ores from the lake shipping points. Next, it is supposed, will come a reduction on coke both to Pittsburgh and Eastern Pennsylvania.

*The rate to Kittanning will not be changed for the present.

THE DEFIANCE EMERY GRINDING MACHINE.

Herewith we illustrate a new emery grinder, which is believed to possess some improvements over other machines for the same purpose, and is most conveniently arranged for grinding knives, bits, gumming saws and general work required about a mill or factory. The frame being a single casting in pedestal form, combines neatness and convenience, with the greatest strength and solidity. The spindle is made from forged steel, and is 1¼-inch diameter, running in self-lubricating bearings, made in halves, filled with genuine babbitt metal. The bearings are so enclosed as to prevent the admission of emery dust. The table is iron 12x24 inches, planed true, with straight and angle rests, nicely fitted. The cone pulley is 4x3 inches and 5x3 inches, giving two changes of speeds, and is capable of carrying wheels from 16 inches diameter, 3 inches thick and sizes under. These machines are built in a most thorough



manner, and guaranteed fully in every particular. A countershaft is furnished when desired as follows: One 30x1 7-16-inch shaft, two No. 0 hangers, two 6x3-inch tight and loose pulleys, one 14x3-inch drawing pulley, one shipper; the spindle should run 1,800 revolutions per minute. Manufactured by the Defiance Machine Works, Defiance, Ohio.

Chicago's Manufactures.

On the authority of Secretary Stone, of the Chicago Board of Trade, it is stated that in 1888 there were 2,400 manufactories in that city, having a capital of $117,000,000, and employing 132,000 workmen, to whom $74,000,000 in wages were paid, and whose aggregate productions were valued at $402,000,000. The following is the summary of industries and the production or business:

	Production or business.
Iron and steel	$24,000,000
Manufactured iron	11,500,000
Dry goods and millinery	85,000,000
Clothing	40,000,000
Boots and shoes	14,000,000
Furniture	16,000,000
Books and papers	43,200,000
Agricultural implements	12,000,000
Crockery	5,000,000
Breweries and malt-houses	13,000,000
Meat production	95,000,000

THE June number of *Lippincott's Magazine* contains the first of a series of papers of extraordinary interest. These are nothing less than the "Recollections of George W. Childs," written from his own dictation by a personal friend. In the present paper Mr. Childs gives a sketch of his early life. This bit of autobiography cannot fail to excite the widest interest, portraying the early struggles and ambitions of a representative American who has made his name famous throughout the civilized world.

FOREIGN COMMENT.

Castings Without Sand.

A Wakefield foundry-man's patent is said to abolish sand in casting pipes. "In superheated steam or gas-jacketed metal moulds" pipes are cast which are uniform, sound and true as if turned or bored by a lathe. The pipes so cast are not porous, and they have other excellent qualities, it is said.—[Glasgow Engineer.

Comparative Value of Manufactured Steel.

Some interesting and curious figures were given in a speech by Sir Daniel Adamson, before the Iron & Steel Institute regarding the comparative value of a ton of manufactured steel. The value of a ton of steel in the shape of steel rails is, say, £4 10s. ($22), but the wholesale price of a ton of steel hair-springs for watches would be £40,080,000 sterling ($200,000,000).

Monster Blast at Crarae.

A monster blast was fired at Crarae Granite Quarry last week. The mine was fired by means of two gutta-percha fuses, measuring together 136 feet. The fuse was lighted at one o'clock, and the ignition of the explosive took place 25 minutes later. It is estimated that about 80,000 tons of rock were displaced. The length of the bore through solid rock was 84 feet. The powder chamber at right angles measured four by three feet. The height of the mine above the quarry floor was 183 feet, and the height of rock above the mine 163 feet.—[Glasgow Engineer.

Chilled Slide Valve.

We learn from *L'Ingenieur-Conseil* that M. Bollinckx is casting the valves of Rider engines in a mould which chills the faces. The chill penetrates to a depth of 1-6 to 1-5 in. As the surface cannot be cut with a tool, it is ground with emery rollers, until a perfectly true and polished face is obtained. It is claimed that not only do these surfaces not wear, but that, thanks to their exceeding smoothness, they do not wear the faces on which they work. Further, the co-efficient of friction is naturally very small. The Administration of State Railways has sent a representative to examine the application of the mode of construction to the slide valves of locomotives. Of course there is nothing novel in the idea of chilling a slide valve face. The plan has already been tried in Great Britain and with a considerable amount of success. It needs, however, a very long time to demonstrate the advantages of a particular construction of slide valves.

Aluminum.

On Friday of last week, Sir Henry Roscoe gave an address on the above subject at the Royal Institution of Great Britain. He pointed out that whereas aluminum was formerly merely a chemical toy, and was bought, half a century ago, at its own weight in gold, recent improvements admitted of its being sold at a price which enabled it to be in daily use. He described the Castner process, carried on by the Aluminum Co., Limited, at Oldbury, and other places, who were now manufacturing 100,000 lbs. per year, being ten times the output a few years ago. Its uses were many, and he showed specimens, produced in the form of foil, tubes, wire, rod and domestic vessels. It bore either a bright or dull surface, and was also used in the manufacture of "silver braid." It did not, like silver, tarnish in the presence of sulphurated hydrogen. Its main use, however, was as an alloy of about 10 per cent. combined with copper and iron, in which it had most important effects. In this connection we may mention that Mr. Cochrane, in his presidential address at the Institution of Mechanical Engineers, last week, said that the presence of one part of aluminum in 800 parts of steel appears, on the authority of Admiral Kolokoltzoff, the director of the gun factory at St. Petersburg, to set the steel entirely free from air bubbles, as the simple outcome of lowering its melting point. In the preparation of the celebrated Mitis castings, Mr. Nordenfelt appears in like manner by the employment of 1-2000th to 1-700th part of aluminum to have succeeded in lowering the melting point of nearly pure iron, so as to enable it to be run into moulds.—[Colliery Guardian.

Must Iron "Go"?

The iron rail trade is now extinct. How long may we expect iron to struggle in the contest against steel in other industries? In ship-building iron has had a brilliant but short career. A hundred years have not yet elapsed since Henry Cort's great invention for rolling iron bars and plates was devised, and nothing in the shape of iron plates of which ships could be built existed. Even fifty years ago few steamers had been constructed of iron. It was to the introduction of iron that we owe the enormous improvement in ocean speed, and with the advent of steel has the sizes of the Atlantic greyhounds been further increased. Are we nearing the limit of size and speed for steamers? In the best informed circles the great lengths of modern steel steamers are condemned. So long as safety is kept in sight by the designers, the great lengths may be an advantage; but the adequate subdivision of under-water bulkheads and water-tight compartments do not receive the attention they deserve. In a large number of steamers a collision bulkhead near the bow, and a bulkhead at the stern is all that is provided; so that the hull is simply a large shell.

The frequency with which iron and steel ships founder after collision painfully impress upon the public mind the dangers of our iron and steel shells. There has been an apalling loss of life and property in the British Channel during the last three months. The most powerful steamers have, after collision with light sailing ships, sunk with lead-like rapidity. The terrible suddenness with which the steamers disappear is due to the scantiness and culpable inefficiency of the subdivision of the hull with water-tight compartments. We are aware that the effectual subdivision of a steamer into water-tight compartments is not so free from difficulty as the general public suppose. Ship-builders are bound to provide for the convenient accomodation of such cargo as the ship is intended to carry, and for its loading and discharge with speed and economy. The point, however, is that these are the first and often only considerations, while the safety of the vessel is only of very secondary importance. In a collision steel does not appear to stand a sudden blow any better than iron. In running on rocks steel has been found the much superior metal, and the only direction in which greater sea-worthiness and safety after a collision lies in greater subdivision of the hull into really water-tight compartments. It would add much to the pleasure of crossing the Atlantic if our huge floating palaces were constructed so that one experienced the sense of satisfaction, that there were no one part of the ship which might not be burst in and filled with the sea, without depriving her of the power to keep her afloat and complete the voyage.—[Iron & Steel Trades Journal.

The Utilization of Basic Slag.

At the closing meeting of the session of the Liverpool Chemists' Association, held in the Royal Institution, Colquitt street, Mr. Thomas Williams, F. C. S., read a paper on the new phosphate which is being derived, as a by-product, from the application of the Gilchrist-Thomas invention, in the Bessemer steel converter. The author traced the history of the discovery, and pointed out its important economic results—(1) in turning into available use iron ores, previously quite unworkable; (2) that the element which constituted the obstruction is now turned into a cinder of extraordinary richness in plant food. When it was remembered that anything beyond the remotest traces of phosphorus in iron or steel was fatal to many uses of those metals, owing to a brittleness it causes, it was not difficult to see what precautions the iron smelter had to observe in the selection of suitable ores for his purpose. Prior to the invention alluded to, it was calculated that only one-eighth part of the iron ores of the world were available for use, the presence of phosphorus in the remaining seven-eighths being too great, producing a pig iron charged to such a degree with phosphorus as to render the metal quite unworkable, also a yield of slag that was practically valueless. The Gilchrist-Thomas invention separated the phosphorus from the iron, rendering it into a state of purity fitted to fulfill any requirement, producing at the same time the phosphatic slag under notice. In elucidation of his subject, Mr. Williams placed before the society the various specimens necessary, including the crude phosphoric pig, containing 2½ per cent. of phosphorus, a bar of about three inches square of basic Bessemer steel, bent double in the cold; sundry specimens of steel plates, etc., which had passed inspections of the Admiralty, Lloyd's, Indian State Railway, etc.; also the basic phosphate, in the state it left the converter, and samples of the same ground into a fine meal ready for farmers' use.

The production of this phosphate, at present enormous, was steadily increasing. It was disintegrated by special machinery, being first curled, crushed, and then ground under edge stones into the finest possible state of division for use. A guaranteed fineness was given of 85 to 90 per cent. to pass through a sieve of ten thousand holes to the square inch, and a percentage strength of from 30 to 40 of the fertilizer phosphate of lime. The leading producers were the North Eastern Steel Co., Middlesborough, and the Glasgow Iron & Steel Co. Mr. Williams, in conclusion, instanced this as another triumph of science towards aiding agriculture, and remarked that it was not so long ago when farmers had to depend altogether upon the gentle influences of animal life, and the slow organic decay of things for manure to raise their crops with. Since then chemical science advanced to their aid an artificial compound prepared from the corrosive fluid of the vitriol chamber and the earth's rocks, and metallurgy, from a boiling cauldron of steel, had come to lend a hand to agriculture in the mysterious work of transforming earth into bread.—[Coal & Iron Trades Review.

American Soft Steel.

The soft steel of Germany has long held a monopolistic place in the iron trades of other countries on account of its superior qualities, and the inability of manufacturers elsewhere to produce its equal. The spell that has so long maintained it in its kingly position now appears to be broken. A short time ago, Mr. C. W. Bildt, chief chemist of the Washburn & Moen Co., in Massachusetts, invented a metal made from ores obtained in the United States, which, after a thorough test of his process, resulted in what is styled a "splendid quality of soft steel." So far as his experiments are concerned, Mr. Bildt's process is complete, and nothing remains to be settled except the cost to the manufacturer, and its comparative relation to the cost of the imported German steel.—[Chicago Journal of Commerce.

THE building of the Manchester canal is progressing rapidly. Nearly one-third of the excavating has been done. There are said to be 20,000 men employed on the work.

LIST OF PATENTS.

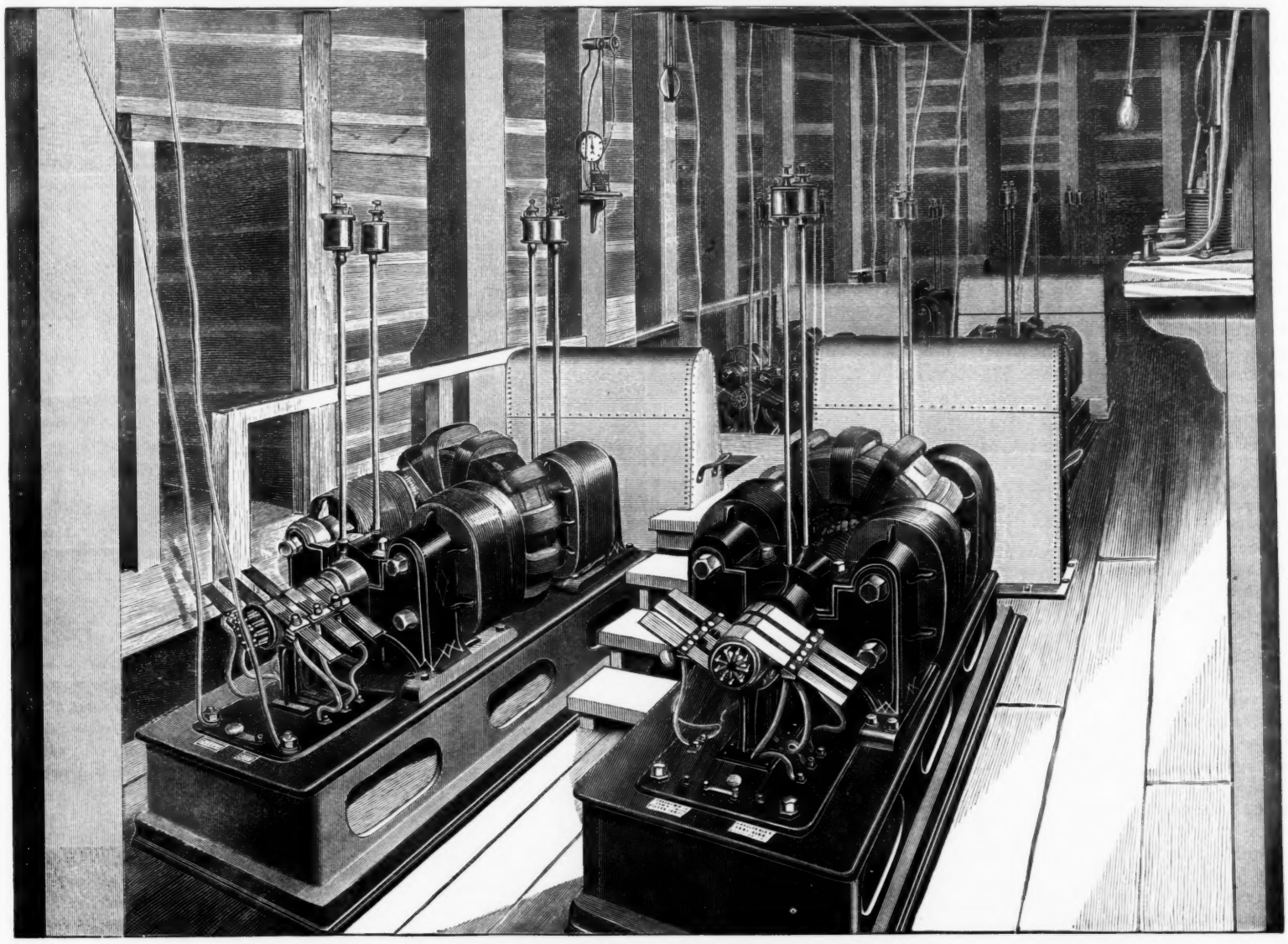
Relating to Iron, Steel, Metal, Machinery, Hardware and Mining Interests.

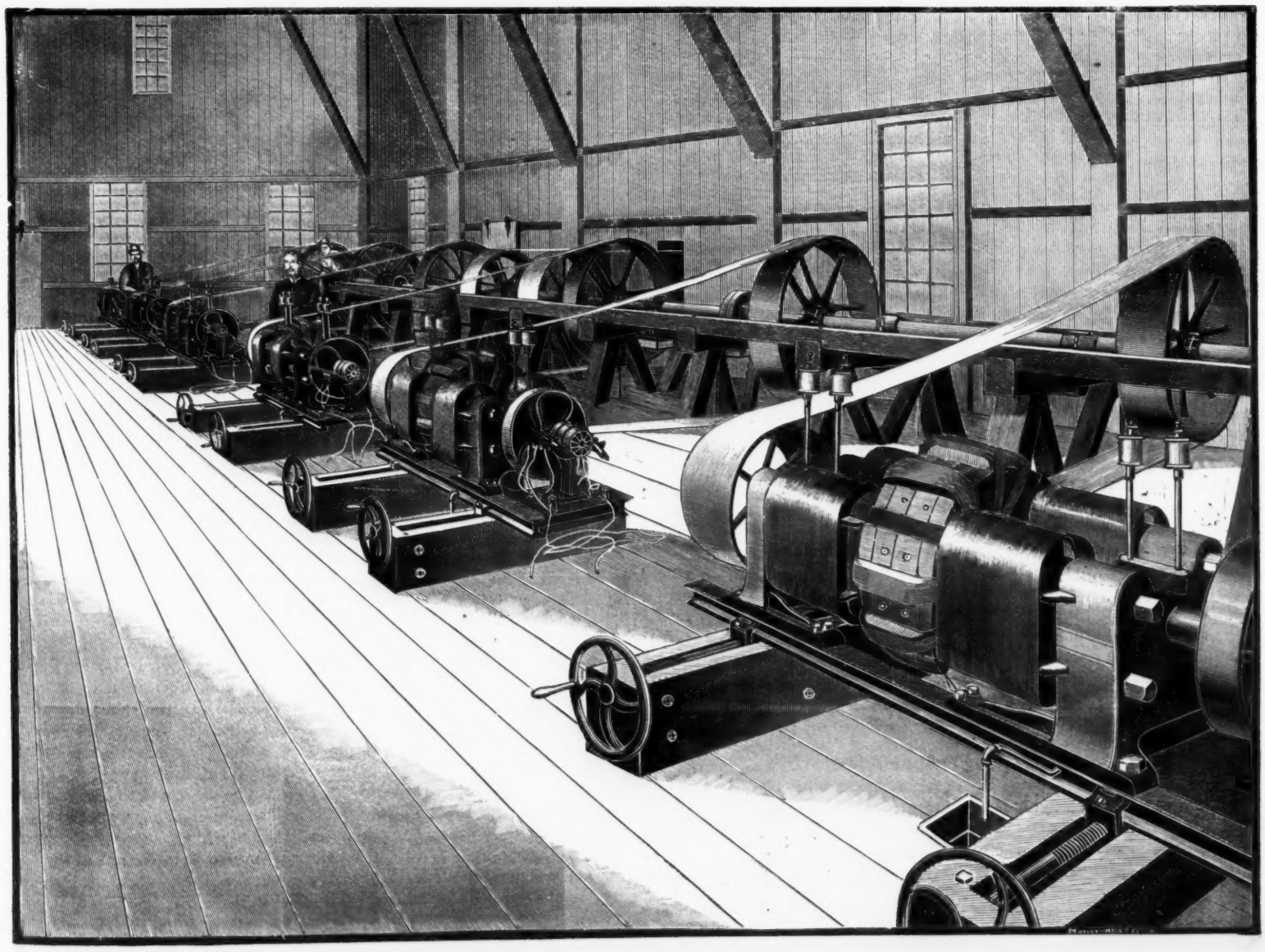
Reported expressly for this paper by H. T. Fisher, (late Ex. U. S. Patent Office), Patent Attorney, 34 Blackstone Building, Cleveland, O.

PATENTS BEARING DATE MAY 21, 1889.

Casting ingots, apparatus for, J. Illingworth, Newark, N. J.
Embossed metallic plate, A. C. Hafely, New York, N. Y.
Forging machine, I. A. Hamer, Reading, Pa.
Iron from ores, machine for separating, G. Conkling, Glens Falls, N. Y.
Metallic strap for boxes, B. H. Gedge, Covington, Ky.
Ore-separator, magnetic, W. R. Thomas, Catasauqua, Pa.
Ores with hyposulphite solutions, leaching, E. H. Russell, New Haven, Conn.
Packing, metallic, R. Weatherburn, London, Eng.
Roofing, metallic, M. F. Hamsley, Nashville, Tenn.
Roofing, sheet metal, A. C. Kannebergh, Canton, O.
Soldering, brazing and welding, electric, E. Thomoson, Lynn, Mass.
Welding and brazing, electric, E. Thompson, Lynn, Mass.
Welding the ends of boiler flues, device for, J Cumming, Bunalo, N. Y.

THE LARGEST ELECTRIC POWER PLANT IN THE WORLD.





THE LARGEST ELECTRIC POWER PLANT IN THE WORLD.*

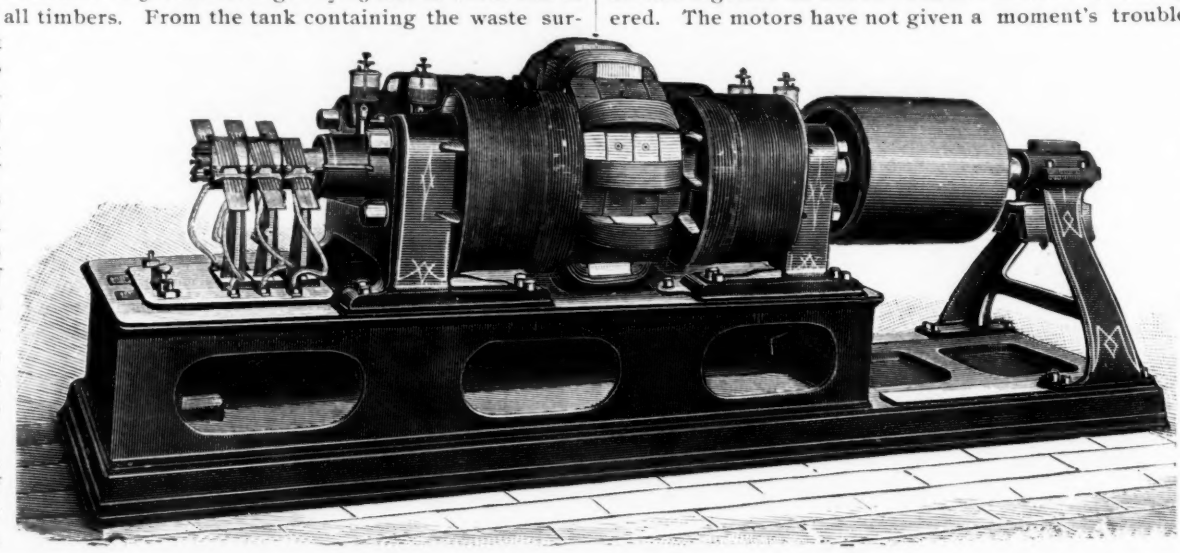
"More power, economical power," has been now for several years the imperative demand of the owners of mining properties on the celebrated Comstock Lode, at Virginia City. The problem has been to work the enormous quantities of low grade ore at a profit. Large sums have been expended in carrying water from streams in the neighboring Sierra Nevada Mountains, for a distance of some 30 miles, to be utilized at the mines and mills on the Comstock. But this supply of water is limited and fickle, and by no means meets the demand. Operations have frequently been suspended on this account, causing great loss to the mine owners and hardship to the laborers dependent upon the active working of the ores.

The best engineering talent of the country has been called to work on this vital problem of power supply, and new arrangements have been made for increasing the amount of water, but vast powers now within reasonable range are still running to waste, which the use of electricity alone can conserve.

At the stamp mill of the Nevada Mill & Mining Co., water power was obtained at the level of the mill from a reservoir on the side of the mountain. The mill contains 60 stamps with their complement of pans, settlers, agitators, rock breakers, etc. The water power readily available was entirely inadequate for the operation of the mill.

The problem was submitted to the Brush Electric Co. through its agents, the California Electric Light Co., of San Francisco. A solution was speedily offered, and the plans were accepted by the owners of the Nevada mill and Chollar mine. The shaft of the latter is close to the stamp mill. It was proposed to collect the waste water from the surface wheel at the mill, convey it in pipes to the shaft of the Chollar mine, and thence down the shaft until a sufficient head should be obtained to produce the power required. The scheme was novel and presented many difficulties. However, experts pronounced the plans feasible, and work was begun last Winter.

At the 1,650-foot level of the Chollar mine a subterranean chamber was excavated out of solid porphyry for the reception of the dynamo electric generators and waterwheels. This chamber is 50 feet in length by 25 feet in width and 12 feet in height, clear of all timbers. From the tank containing the waste surface water two wrought iron pipes are led to the subterranean chamber, one ten and one eight inches in diameter. At the bottom of the shaft a Y unites these two pipes into a single one, 14 inches in diameter, out of which six six-inch pipes run to the nozzles of the waterwheels provided to drive the large Brush dynamo electric generators.



BRUSH DYNAMO-ELECTRIC GENERATOR, 130 HORSE-POWER.

The underground electrical station is of the most interesting character, and is shown in our illustrations. The large Brush primary generators, of which there are six, are adapted to the conditions by a few mechanical changes from the standard pattern. They are mounted on a heavy cast iron base, and are provided with an extended shaft and outer bearing. On the armature shaft and between two bearings, the Pelton wheel is mounted and enclosed in a water-tight cover. The cut of the generator is made from a photograph taken at the Brush Electric Co.'s Works, at Cleveland, before shipment, and shows a pulley on the armature shaft, arranged for testing runs at the factory. The waterwheel is attached to the armature shaft at the place occupied by this pulley, and a coupling is provided for detaching this entire end of the shaft carrying the wheel from the other end carrying the armature.

These Brush generators are each of 130-horse power capacity, and are compound wound for constant current. The electrical curve from these machines is almost ideally perfect, and they require no regulator whatever. The current remains of constant strength under all conditions of load.

The head of water at the underground chamber is 1,680 feet. It has never before been attempted to run a waterwheel under such enormous pressure. This was indeed one of the most serious problems involved in the remarkable installation. From the various excellent forms of waterwheels the "Pelton" was selected as best adapted to work under the special circumstances. This wheel is the outgrowth of the old hurdy-gurdy form, and, as will be very readily understood its buckets are provided with a very ingenious wedge-shaped partition, by which the stream of water is divided, and sweeps out through the curved sides in such a way as to produce a reactionary effect in addition to the impact. By the peculiar construction of the buckets, all the water is also thrown down and out of the way of the wheel. The six Pelton wheels are each 40 inches in diameter, are made of phosphor bronze, and weigh 220 pounds. They drive the generators at a rate of 900 revolutions per minute. The compact arrangement of combined dynamo generator and waterwheel makes it almost impossible for the visitor to the underground chamber to realize the enormous amount of power here at work. The machines are placed in parallel rows of three, and the swift revolving armatures are all that can be seen in motion as evidence of the 800-horse power generated. The chamber is brilliantly lighted by 36 Swan incandescent lamps, operated in multiple series from one of the Brush generators, and there are several of the same lamps in the incline. Each generator circuit is provided with a dead beat ammeter of the Brush pattern, and a Brush voltmeter is also at hand, which is capable of measuring up to 3,000 volts. The generator circuits are led to a switchboard in the same dynamo-room, where any generator can be thrown on to any one of the outgoing motor circuits.

Leaving this subterranean power station and ascending the Chollar shaft are the circuits of copper wire, one to each generator. At one point these circuit wires pass through a shower bath of spray, but the insulation is so perfect that no leakage has yet developed. The wires issue from the mine shaft and are carried above ground to the electric motor room at the Nevada Mill. The total length of each circuit is a little more than a mile.

The electric motor room is shown in one of the large illustrations. The six motors are of the regular Brush constant current type, each of 80-horse power capacity, and are arranged in a single row parallel with the main driven shaft to which they are all belted in the ordinary manner. The surface waterwheel is also connected to this same shaft. It will be noted that there is here a very novel and interesting feature. This surface wheel uses the water in the first instance and furnishes part of the power to drive the main shaft. The waste water after this primary use, is carried down the Chollar shaft to the underground chamber where it drives the dynamos which generate the electric current and energize the electric motors above ground, which, in turn, furnish additional power to the main shaft.

Each electric motor has its own independent circuit fed from one of the generators. The well-known Brush centrifugal governor with which each motor is fitted, regulates the speed sensitively, and all or any number of the motors work perfectly in a battery together or with the waterwheel. In the motor room there is also an ammeter for each electric motor to show at all times the current flowing in each circuit. The motors run at a speed of 850 revolutions per minute. Some difficulty was anticipated in operating the motors together on one shaft in the manner described, but none was encountered. The motors have not given a moment's trouble or annoyance of any kind from the start.

Some idea of the economic value of this electric power plant to the mine owners may be got from a statement of the saving effected by it. The surface wheel alone requires 312 miner's inches of water to develop power sufficient to drive 40 of the 60 stamps with which the mill is equipped. Moreover, this amount of water is seldom available. Two of the electric motors, working in addition to the surface wheel, will perform the same service with but 27 miner's inches of water, thus effecting a saving of about 77 per cent.

The net commercial efficiency of the plant, taking into account all elements of loss, including that in the conducting wires, is about 70 per cent. In other words, 70 per cent. of the power applied to the shafts of the generators in the underground chamber, is delivered for work at the main line shaft in the mill.

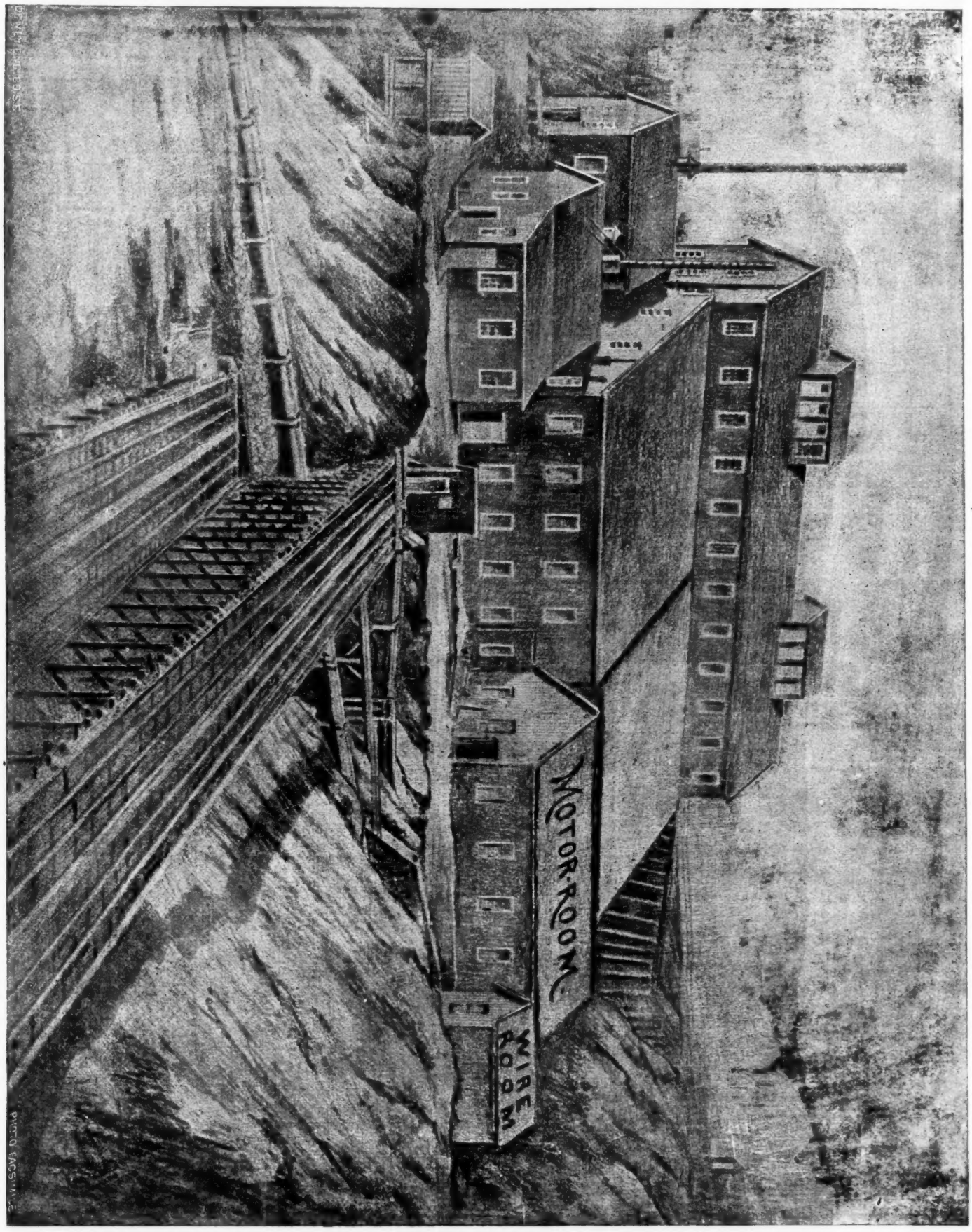
The waste water from the 1,650-foot level of the Chollar mine is piped into the Sutra Tunnel. It is now proposed to use this water a third time at a lower level for other work by means of a similar application of electrical machinery.

It was expected at the outset that many difficulties would be met in an installation of such novel and original character, which was also by far the largest ever attempted. The projectors, the Brush Electric Co. and their agents, the California Electric Light Co., who assumed charge of the details of the erection, were very greatly pleased to find that their forethought had eliminated the troubles anticipated and predicted in almost all respects. Two purely technical difficulties were encountered when the plant was started experimentally, which caused some delay and anxiety. They were, first, the lack of any governing appliance for the waterwheels, and second, the damage to the primary generators caused by the extreme heat and dampness in the underground station.

The Brush Electric Co. in its original plans and specifications, stipulated that the waterwheel should be governed within reasonable limits, but this requirement was not met, and the first generator and motor, started up experimentally, showed the necessity of this provision. The Brush Co. was surprised to receive by the telegraph the first intimation that the makers of the waterwheels had wholly neglected such an important matter, but was fortunately able to close the breach at once. A waterwheel governor, invented and sketched out by Mr. W. B. Devereux, the prominent mining engineer, of Aspen, Colo., had been placed in the hands of the company some time previously, and working drawings of it had been made at Cleveland. These were at once sent to California, the governors were quickly made, and this source of trouble was overcome. Mr. F. E. Smith, the electrical engineer in charge of the installation, made several modifications of the governor, after watching its performance, which proved of much value, and it has worked perfectly in practical service.

The second difficulty was met with equal promptness and likewise entirely

*Of the cuts on the opposite page, the upper one represents the underground power station (Brush machines) at the 1,650-foot level of the Chollar mine, and the lower one the Brush electric room motor at the Nevada stamp mill.



MOTOR ROOM OF THE NEVADA STAMP MILL AT VIRGINIA CITY, NEV.

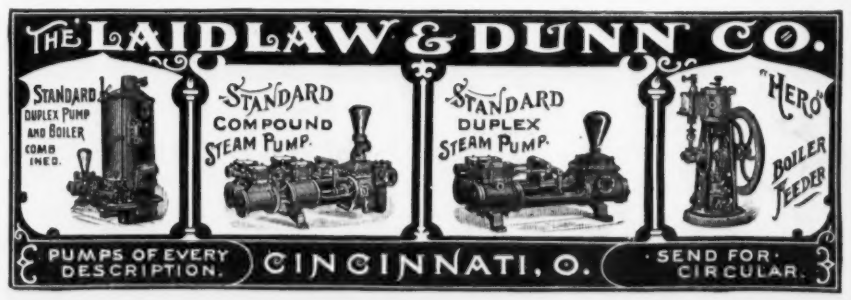
overcome. The temperature of the subterranean power chamber is about 72 degees F. The atmosphere is almost saturated with moisture—78 per cent. Any piece of the metal taken into it begins immediately to "sweat." The generators when placed in this chamber were soon covered and saturated with moisture, and began to show leaks, while the motors above ground were absolately free from any trouble.

The Brush Co. was at once notified of this unanticipated source of difficulty, and Mr. Brush speedily devised a method of insulation which would certainly and completely resist the moisture of the atmosphere. Since its application the generators have worked admirably, and the entire plant is now at work regularly, performing its expected duty, and economizing the power available, as stated above.

The achievement of the Brush Electric Co., in connection with this plant on the Comstock, is a very notable one, and of the greatest interest to mining engineers. The plant is the largest electrical power plant in the world. The company is making a specialty of powerful generators and motors for power transmission and distribution, and is taking large orders for them, not only in this country, but also for foreign shipments. The latest contract announced is one with the Calumet & Hecla Mining Co. for five of the large Brush generators of 130-horse power, and five of the 80-horse power Brush motors. A power station will in this case be built above ground for the generators, and the motors will be used for driving pumps underground. The plant goes to the copper mine at Calumet, Mich.

Locomotives Run by Soda.

Four locomotives run by steam-heated soda have been built in Philadelphia for use on a street railway in Minneapolis, Minn. The boiler holds five tons of soda, which, on being subjected to steam, gives out intense heat, from which the motive power is derived.



IRON AND STEEL MARKETS.

PIG IRON.

CLEVELAND (f. o. b. cars, four months): Bessemer, $17 00@00 00; No. 1 Foundry, $15 65@16 15; No. 2 Foundry, $14 65@15 15; No. 1 Gray Forge, red short, $13 65@14 15; No. 2 Gray Forge, neutral, $13 15@13 65; No. 1 American Scotch, $16 90@17 55; No. 2 American Scotch, $15 90@16 55.

CHICAGO (reported by Rogers, Brown & Co.): CHARCOAL IRONS—L. S. Nos. 1 and 2 Foundry, $18 00@19 00. Southern C. C. Foundry, $17 00@13 00; H. R. C. C. Foundry, $20 00@23 00. COKE AND BITUMINOUS—Ohio H.R. Strong Softeners No. 1, $18 25@00 00; Ohio H. R. Strong Softeners No. 2, $17 25@00 00; Ohio Hocking Valley Strong Softeners No. 1, $17 75@00 00; Ohio Hocking Valley Strong Softeners No. 2, $16 75 @00 00; Ohio Hocking Valley Silvery Softeners No. 1, $17 00@00 00; Ohio Hocking Valley Silvery Softeners No. 2, $16 00@00 00; Ohio Black Band Softeners No. 1, $18 00@18 50; Ohio Jackson Co. pure Softeners No. 1, $17 75@18 25; Ohio Jackson Co. pure Softeners No. 2, $16 75 @17 75; Norton & Ashland Brands, Ashland, Ky., pure Softeners No. 1, $17 00@17 50; do. No. 2, $16 00@16 50; Southern Coke Foundry No. 1, $16 00@00 00; Southern Coke Foundry No. 2, $15 25@00 00; Southern Coke Foundry No. 3, $14 75@00 00; Southern Coke Softeners No. 1, $15 25@00 00; Southern Coke Softeners No. 2, $14 25@00 00; Southern Coke Grey Forge $13 75@14 00; No. 1 Foundry (local furnaces at Chicago and in Northwest) $15 50@16 00; No. 2 Foundry $14 50@15 00; No. 3 Foundry $13 50 @14 00. CAR WHEEL AND MALLEABLE—Lake Superior Nos. 1 to 6, $18 50@19 50; Standard Southern Nos. 3 to 6, $19 00@19 50; Hanging Rock Cold Blast $23 50@26 00; Hanging Rock Warm Blast $21 00@23 00

CINCINNATI (reported by Rogers, Brown & Co.): HOT BLAST FOUNDRY—Ohio and Southern Coke No. 1, $14 75@15 25; Ohio and Southern Coke No. 2, $14 00@14 50; Ohio and Southern Coke No. 3, $13 25@13 75; Ohio Soft Stone Coal No. 1, $15 75@16 50; Ohio Soft Stone Coal No. 2, $14 75@15 50; Mahoning and Shenango Valley, $16 00@16 50; Hanging Rock Charcoal No. 1, $20 00@22 00; Hanging Rock Charcoal No. 2, $19 00@21 50; Tennessee and Alabamba Charcoal No. 1, $17 50@18 50; Tennessee and Alabama Charcoal No. 2, $16 50@17 50. FORGE—Strong Neutral Coke, $12 75@13 25; Mottled Neutral Coke, $12 00@12 50; Cold Short Coke, $12 75@13 00. CAR WHEEL AND MALLEABLE—Southern Car Wheel, $23 00@24 50; Hanging Rock Cold Blast, $22 00@25 00; Lake Superior Malleable and Car Wheel, $20 50@21 00.

LOUISVILLE (reported by Geo. H. Hull & Co.): Southern Coke No. 1 Foundry (new classification), $14 75@15 25; Southern Coke No. 2 Foundry (new classification), $14 25@ 14 75, Southern Coke No. 3 Foundry (new classification), $13 75@14 25; Grey Forge, $13 25@13 75; White and Mottled, different grades, $12 75@13 25; Silver Grey, different grades, $13 00@13 50; Southern Charcoal No. 1 Foundry, $16 25@16 75; Southern Charcoal No. 1 Mill, $14 75@15 25; Southern Car Wheel, Standard brands, $21 75@22 75; Southern Car Wheel, other brands, $18 00@19 50; Hanging Rock Coke No. 1 Foundry, $15 50@16 00; Hanging Rock Charcoal No. 1 Foundry, $19 50@ 21 00; Hanging Rock Cold Blast, $20 75@22 75; Hanging Rock Warm Blast, $00 00@00 00.

ST. LOUIS (reported by Rogers, Meacham & Shields): HOT BLAST COKE AND CHARCOAL—Southern Coke No. 1, $15 25@16 00; Southern Coke No. 2, $14 75@15 25; Southern Coke No. 3, $14 25@14 75; Southern Grey Forge, $13 25@ 13 75; Southern Charcoal No. 1, $18 00@18 50; Southern Charcoal No. 2, $17 00@18 00; Missouri Charcoal No. 1, $16 00@16 50; Missouri Charcoal No. 2, $15 00@16 00; Ohio Softeners, $17 00@ 19 00. CAR WHEEL AND MALLEABLE IRONS—Lake Superior, $19 75@22 00; Southern, $19 00@ 23 00. CONNELLSVILLE COKE—East St. Louis, $4 40; St. Louis, $4 55.

DETROIT (reported by William F. Jarvis & Co.): Lake Superior Charcoal, all Numbers, $19 50@20 00; Lake Superior Coke, all Ore, $18 00@19 00; Lake Superior Coke, Cinder Mixed, $17 75@18 25; Standard Ohio Black Band, $18 00@19 00; Southern No. 1, $17 00@ 17 50; Southern Gray Forge, $15 00@15 50; Southern Silvery, $16 00@16 50; Jackson County (Ohio) Silvery, $18 00@18 75; Old Wheels, $18 50 @19 00.

PITTSBURGH (reported by A. H. Childs): No. 1 Foundry, $16 00@16 50; No. 2 Foundry, $15 00@15 50; No. 1 Mill, $14 25@14 50; White and Mottled, $13 00@13 50; Warm Blast Charcoal, $19 00@22 00; Cold Blast Charcoal, $22 00 @28 00; Bessemer, $16 25@16 50.

MERCHANT IRON AND STEEL.

Flat Bar.

1½ to 4 by ⅜ to 1 inch	1 70
4¼ to 6 by ⅜ to 1 inch	1 80
1¾ to 6 by 1¼ to 2 inch	2 10
1¼ & 1⅜ by ⅜ to ¾ inch	1 80
1 & 1⅛ by ⅜ to ¾ inch	1 80
⅜, ¾ and ⅞ by ⅜ to ⅝ inch	2 20

Round and Square.

1 to 1⅞ inch	1 70
2 to 2⅝ inch	1 90
2¾ to 3¼ inch	2 20
3⅜ to 4 inch	2 70
4⅛ to 4½ inch	3 20
4¾ to 5 inch	3 40

Oval.

⅜ to 1¼ inch	2 10
⅜ to ¾ inch	2 30
½	2 50
⅝	2 90

Half Oval and Half Round.

1⅛ to 3 inch	2 80
⅜ to 1¼ inch	2 40
⅜ to ¾ inch	2 90
½	3 20
⅝	4 70

Heavy Band.

⅛ to 6 by ¼ and 5-16 inch	1 95
1 to 1⅜ by ¼ and 5-16 inch	2 05
¾ to ⅞ by ¼ and 5-16 inch	2 25
⅛ to ⅜ by ¼ and 5-16 inch	2 75

Hoops.

1¼ to 4, Nos. 13 to 15	2 55
1¼ to 2, Nos. 16 to 18	2 65
1¼ to 2, No. 19	2 75
1¼ to 2, No. 20	2 85
1¼ to 2, No. 21	2 95
1¼ to 2, No. 22	3 05
15-16, 1 and 1⅛, Nos. 13 to 15	2 75
15-16, 1 and 1⅛, Nos. 16 to 18	2 85
15-16, 1 and 1⅛, Nos. 19 and 20	2 95
15-16, 1 and 1⅛, No. 21	3 05
15-16, 1 and 1⅛, No. 22	3 25
⅞, Nos. 13 to 15	2 95
⅞, Nos. 16 to 18	2 05
⅞, Nos. 19 and 20	2 15
⅞, No. 21	3 25
⅞, No. 22	3 35
13-16, Nos. 13 to 15	3 15
13-16, Nos. 16 to 18	3 25
13-16, Nos. 19 and 20	3 35
13-16, No. 21	3 45
13-16, No. 22	3 55
¾, Nos. 13 to 15	3 25
¾, Nos. 16 to 18	3 35
¾, Nos. 19 and 20	3 45
¾, No. 21	3 55
¾, No. 22	3 65
11-16, Nos. 13 to 15	3 45
11-16, Nos. 16 to 18	3 55
11-16, Nos. 19 and 20	3 65
11-16, No. 21	3 75
11-16, No. 22	3 85
⅝, Nos. 13 to 15	3 85
⅝, Nos 16 to 18	3 75
⅝, Nos. 19 and 20	3 95
⅝, No. 21	4 05
⅝, No. 22	4 15
⅝, No. 23	4 25

Light Band.

1½ to 6 by ⅛ to 3-16 in	2 25
1½ to 6 by Nos. 11 and 12	2 35
1 to 1⅜ by ⅛ to 3-16 in	2 35
1 to 1⅜ by Nos. 11 and 12	2 45
⅞ and 13-16 by ⅛ to 3-16 in	2 65
⅞ and 13-16 by Nos. 11 and 12	2 75
¾ and 11-16 by ⅛ to 3-16 in	2 95
¾ and 11-16 by Nos. 11 and 12	3 05
⅝ and 9-16 by ⅛ to 3-16 in.	3 25
⅝ and 9-16 by Nos. 11 and 12	3 30
½ by ⅜ to 3-16 in	3 50
½ by Nos. 11 and 12	3 60

Wagon Box Iron.

⅞ inch, beveled edge, by Nos. 11 and 12	2 75
⅞ inch, " " " 13 and 14	3 05
¾ inch, " " " 11 and 12	3 05
¾ inch, " " " 13 and 14	3 25

Sheet Iron.

No. 10 to 14	2 50
No. 15 to 17	2 70
No. 18 to 21	2 80
No. 22 to 24	2 90
No. 25 to 26	3 00
No. 27	3 10
No. 28	3 30

Iron Boiler Plates.

Tank, ¼ inch and heavier	2 35
C No. 1, " "	2 60
C H No. 1 " "	2 85
C H Flange, " "	3 55
Extra Flange, "	3 95
Solid Fire Box, "	4 85

Steel Boiler Plates—1-4 in. and Heavier.

Tank	2 55
Shell	2 95
Flange	3 20
Marine Flange	3 70
Fire Box	4 35

Above includes plates 90 inches wide.

90 to 96 in. wide	½c lb extra
96 to 100 in. wide	1 c "
100 to 104 in. wide	1½c "
104 to 116 in. wide	special

American Cast Tool Steel.

ROUND, SQUARE AND OCTAGON.	cts. lbs
1 to 2 in. inclusive	09
9-16 to ½ in "	09
7-16 to ⅜ and 2⅜ to 3 in	10½
3⅛ to 4 in	11
⅜ to 11-16 and 4⅛	10½
⅛ to 6 in	11½
¼ to 9-32 and 6⅛ to 7 in	12
3-6 in	14

Flats.

	cts. lbs
2 to 9-16 wide by 2 to ⅝ thick	0

Bessemer and O. H. Steel.

	ct. lb
Machinery	base price, 02¾
Tire	" 02¾
Spring	" 03¼
Sleigh Shoe	" 02¾
Toe Calk	" 03
Cutter Shoes, tapered and burr.	" 03

English Tool Steel.

Jessop's	16c
Hobson's "Best"	16c
" "Choice"	36c

Burden Boiler Rivets.

½, ⅝, 11-16 and ¾ inches diameter	4 00
Bridge ½, ⅝, 11-16 and ¾ inch diam	4 00

SCRAP IRON AND OLD METAL.

	Net Ton.
No. 1 R. R. wrought scrap	$17 50
No. 1 wrought scrap	15 00
No. 1 Machine cast scrap	12 00
Stove Plate (free from burnt iron)	10 00
Grate Bars	8 50
Pipes and flues (Clean)	13 00
Tank iron	12 50
Hoop and band iron	10 00
Iron axles	24 00
Light sheet iron	10 00
Axle turnings	14 00
Wrought turning (free from cast)	12 50
Wrought iron, oily drillings	11 00
Cast borings	9 00
Malleable iron	10 00
Uncut wrought iron boilers	10 00
Steel boiler plates	14 50
Old iron T rails	gross tons 22 00
Old steel rails	18 50
Car wheels	20 00
Old copper	₩ lb 10
No. 1 H. red Brass	11
Heavy yellow brass	8½
Light yellow brass	6
Scrap Zinc	
Tea Lead	
Heavy Lead	3¼

PITTSBURGH & WHEELING COAL CO.,
MINERS AND SHIPPERS OF
Ohio Steam Coal and Coke.
Mines on the Cleveland, Lorain & Wheeling R. R. Capacity, 3,000 tons daily.
Office, 29 Mercantile Bank Building, CLEVELAND, OHIO.
Lake Shipping Point, Lorain O.
JAS. PATTERSON, Sales Agent.

MIDVALE TOOL STEEL & C. STEEL BLOOMS BILLETS AND SLABS — W. F. THORNTON, CLEVELAND O.

CLEVELAND ROLLING MILL CO.,
MANUFACTURERS OF
BESSEMER STEEL RAILS,
Blooms and Billets, Steel Angles, Forgings, Bar and Spring Steel, Steel Street Rails, Steel Oil Barrel Hoops, Wire of all Kinds, Iron and Steel Boiler Plates, Galvanized and Black Sheet Iron, Corrugated Iron Roofing, Sheet Steel.

Soft Steel Plates and Sheets,
CORRUGATED ROOFING!
Galvanized Iron. Patented Leveled Sheet.
THE STANDARD IRON COMPANY,
BRIDGEPORT, OHIO.

WANTED.
Good Second-Hand Engines, Boilers and other Machinery, Plates and Castings, suitable for use in a Rolling Mill. Give dimensions, condition, etc., in detail, with bottom prices on cars for cash. Address, P. O. BOX 323, Cincinnati, O.

TUTTLE, OGLEBAY & CO.,
Commission Dealers in
Iron - Ores.
FROM MARQUETTE, GOGEBIC AND MENOMINEE DISTRICTS,
CLEVELAND, OHIO.

Pickands, Mather & Co.,
IRON ORE - -
—AND—
- - PIG IRON
Corner Bank and Superior Streets,
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J. H. OUTHWAITE. W. G. POLLOCK.
J. H. OUTHWAITE & CO.,
Exclusive attention given to
LAKE SUPERIOR AND MENOMINEE RANGE
Iron Ore.
CLEVELAND, OHIO.

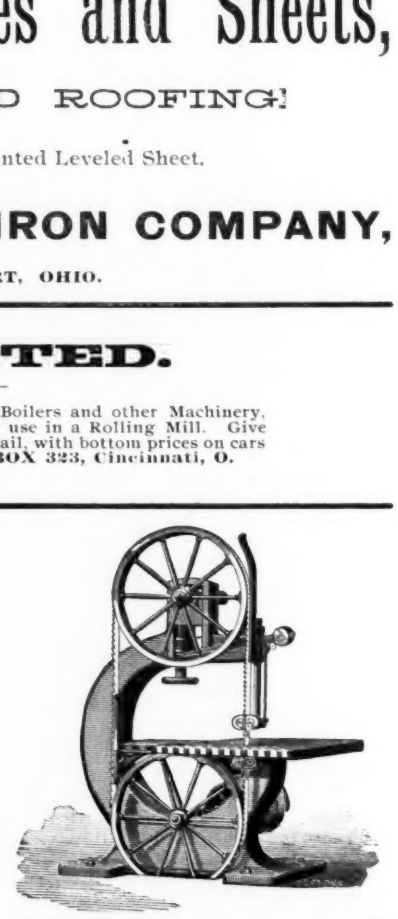
CONDIT, FULLER & CO.,
Pig and Bar Iron,
CLEVELAND, OHIO.

DALLIBA, CORRIGAN & CO.,
DEALERS IN
Iron Ore & Pig Iron.
101 St. Clair St., Rooms 20 to 22,
CLEVELAND, O.

H. P. Hussey. Geo. H. Pomeroy.
HUSSEY & POMEROY,
EXCLUSIVELY PIG IRON,
Strong Foundry and American Scotch Irons, Gray Forge and Bessemer Irons for steel purposes.
Room 57, Grand Arcade, Cleveland, O.

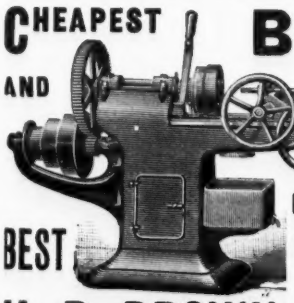
E. C. POPE,
COMMISSION DEALER IN
Iron Ore, Pig Iron and Metals.
CLEVELAND, OHIO.

THE MORGAN MACHINE CO.,
MANUFACTURERS OF
Universal Milling Machines, Special Tools and Gauges, Milling Cutters, Popular Bevel Protractor, Gear Cutting, General Jobbing.
41 West Superior St. (Viaduct.) CLEVELAND, O.



$80 will buy the best band saw in the world.
$100 will buy our new patent 40-inch band saw.
$185 will buy our new patent band re-sawing machine.
$125 will buy the best automatic rip-sawing machine. Weatherboarding attachment included, and one 12-inch rip saw. For further particulars address
STANDARD MFG. CO.,
MOORE'S HILL, IND.

E. H. JONES & CO.,
223 and 225 River St., CLEVELAND, O.
ENGINEERS AND CONTRACTORS.
Worthington Steam Pumps, Electric Light Engines and Automatic and Slide Valve Engines of all Descriptions.
Steam Plants, Complete, Furnished and Set Up.

CHEAPEST AND BEST BOLT CUTTERS. EVERY SIZE & STLYE.

H. B. BROWN & CO.,
EAST HAMPTON, CT.
We allow One Dollar to every purchaser sending us this advertisement.

MACHINERY SUPPLY MARKET.

Anvils.

American ..... ₩ lb 9@10
Wrights ..... ₩ lb 9½

Bellows.

Blacksmiths' { Hill's ..... dis 40
Blacksmiths' { Bullock's .... dis 50&10
Moulders' ..... dis 40@40&10
Hand ..... dis 40&10@50

Belting.

Boston Belting Co's standard ..... dis 70@70& 5
" " " extra ..... dis 60&5@60&10
" " " best ..... dis 55
Hoyt's Short Lap ..... dis 45
Cleveland Rubber Co. extra standard dis 60&10
Shultz Raw Hide Leather Belting, single ..... dis 30
Shultz Raw Hide Leather Belting, double ..... dis 35
Standard, oak tanned ..... dis 55@60
Alexander Brothers' pure oak tanned. ... dis 45

Blowers and Exhausters.

B. F. Sturtevant's ..... dis 20
Boston Blower Co., ... dis 35
Buffalo ..... dis 35

Borax.

..... ₩ lb 9½@10½

Chalk.

White ..... ₩ gross 50
White Crayon ..... ₩ gross 12@12½ dis 10
Red ..... dis 70
Blue ..... dis 85

Chucks.

Cushman's 4 Jaw Independent ..... dis 40
" Combination ..... dis 40
" Geared Scroll ..... dis 30
" 2 Jaw Brass Workers. ..... dis 25
" Drill ..... dis 35
Wescott's Scroll Combination ..... dis 30
" Independent ..... dis 40
" Little Grant Drill ..... dis 30
Horton's Universal & Ind ..... dis 40
National Combination ..... dis 40
Sweetland " ..... dis 40
Skinner " ..... dis 40
" Independent ..... dis 40
Almond Drill ..... dis 25
Morse " ..... dis 15
Skinner " ..... dis 30

Cutters and Reamers.

Cleveland ..... dis 10@15
Pratt & Whitney ..... dis 10@15
Standard ..... dis 10@15
Brown & Sharpe, Milling Cutters ..... dis 15
" " Gear Cutters .. .. dis 15

Crowbars.

Cast Steel ..... ₩ lb 4
Iron, steel points ..... ₩ lb 3½

Drill and Drill Stocks.

Twist drills ..... dis 50&10
Morse Taper and Straight shank to 1½" ..... dis 50&10
Morse Taper and Straight shank Larger than 1½" ..... dis 25
Drill Sockets ..... dis 20
Standard ..... dis 50&10
Cleveland ..... dis 50&10

Emery.

	No. 4 to 46 gr.	No. 54 to 150. gr.	Flour, F.	C. F. FF.
Kegs, ₩ lb	4 c	5 c		2½c
½ kegs ₩ lb	4¼c	5¼c		2¼c
¼ kegs ₩ lb	4½c	5½c		3 c
10 lb cans, 10 in case	6 c	6½c		5 c
10 lb cans, less than 10	10 c	10 c		7½c

Emery Cloth and Paper.

Barder, Adamson & Co. ..... dis 40@46
H. H. Barton ..... dis 40@46

Emery Wheels.

Detroit ..... dis 50@60
Norton's ..... dis 55@60
Grant ..... dis 55@60
Union Stone ..... dis 60
Sterling ..... dis 60
Vulcanite ..... dis 15@20
Celluloid ..... dis 10
Northampton ..... dis 55
Crystal ..... dis 65@70
Vitrified ..... dis 60

Files.

Nicholson ..... dis 60&10@60&10&10
" X. F ..... dis 25
Kearney & Foot ..... dis 60&10@60&10&10
Black Diamond ..... dis 60&10@60&10&10
Arcade ..... dis 65@70
Disston's ..... dis 65@70
Western ..... dis 70
Stub's ..... dis 25
Grobet's ..... dis 30
Reynolds Bros.' Hand Cut ..... dis 50

Hammers.

P. S. W ..... dis 40
Atha new list, Jan. 15, 1887 ..... dis 50
Heavy hammers and sledges under 5 lbs. 18c over 5 lbs 14c, new list.

Jack Screws.

Illinois Bolt Co. list ..... dis 70

Nuts and Washers.

Size of bolt inches	¼	5-16	⅜	½	⅝	¾	1
Square	8	7	5½	4¼	4	3¼	3⅓
Hexagon	15⅓	11½	8⅓	6	5¼	5¼	5
Washers	9	8	7	5	4½	4½	4½

In lots less than 100 lbs, ₩ lb add ½c., 1 lb boxes add 1c to list.

Nails (wire.)

List July 14, 1887 ..... dis 70 &10
Standard Penny Nails, ₩ keg card rate
{ Car lots $2.50
{ Less than car lots $2.60

Oilers.

Zinc and Tin ..... dis 60
Brass and Copper ..... dis 50
Malleable (Hammer's), No. 1, $3.60; No. 2, $4.00; No. 3, $4.40 ₩ doz ..... dis 10@10&10

Packing, Steam.

Boston Belting Co. ..... dis 60
American Packing Hemp ..... ₩ lb 10@11
Russia Packing " ..... ₩ lb 14
Italian Packing " ..... ₩ lb 13@14
Plumbago Piston ..... ₩ lb 40
Morrison's " ..... ₩ lb 50
Square Flax " ..... ₩ lb 70
Sheet Rubber ..... ₩ lb 12@24
Excelsior Rubber. ..... ₩ lb 48

Picks.

Railroads, 5 to 6 lbs ..... $12 dis 60&5@60&10
" 6 to 7 lbs ..... $13 dis 60&5@60&10

Pulleys.

Iron Pulleys, Walker List ..... dis 45
Medart Pulleys ..... dis 55
Split Wood Pulleys ..... dis 45

Rivets.

Iron, Thousand, list November 17, ... dis 50@50&10
Iron, Ordinary, Cooper's Block and Carriage list November 17 ..... dis 50
Copper ..... dis 50@50&10

Rope.

Manilla, ½ inch and over ..... ₩ lb 15¾
Sisal, ½ inch and over ..... ₩ lb 13¾

Sand Paper.

B. A. & Co ..... dis 40@40&10
H. H. Barton's ..... dis 40@40&10
New England Flint ..... dis 40@40&10
Barton's Garnet ..... dis 20

Saws.

Disston's Circular ..... dis 45
" Band ..... dis 20
" Scroll ..... Net
Hack Saw Stubs ..... dis 20
" " Eureka ..... dis 20
" " Star ..... dis 20
Saw Swages Disston's ..... dis 20
Atkins' Cicular Saws ..... dis 50
" Mill, Mulay and Drag Saws .. dis 40&10
" Wood Saws ..... dis 40&10
" Silver Steel Diamond Cross-cut Saws ..... dis 70c per ft
" Dexter Cross-cuts ..... dis 50c "
" Diamond " ..... dis 30c "
" Tuttle Tooth Cross-cuts .. dis 25c "
" One-man Cross-cuts ..... dis 32c "
No. 1 Handles ..... dis 23c per pair
No. 6 " ..... dis 16c "
Excelsior Saw Tools ..... $6 per doz
Perfection " ..... $15 "

Screws.

Wood Screws—List Jan 27, 1889.
Flat head iron ..... dis 50
Round head iron ..... dis 40
Flat head brass ..... dis 45
Round head brass ..... dis 35
Square Cap ..... dis 65
Hexagon Cap ..... dis 60
Set C. H. C. P ..... dis 70
Machine, flat head, iron ..... dis 55
Machine, round head, iron ..... dis 50
Bench and hand—
Lag or coach ..... dis 75@75&10
Coach, patent gimlet point ..... dis 75

Shovels and Spades.

Ames' list November 1, 1885 ..... dis 20
Dennis ..... dis 5.25
Hussey & Binns, railroad ..... dis 8.00

Taps.

Cards, Hand and Nut to 2 in ..... dis 50
Carpenters' " " " ..... dis 50
Morse " " " ..... dis 50
Pratt & Whitney " " ..... dis 25
Machine Screw Taps ..... dis 55
Pipe Taps to 2½ in ..... dis 70
Stay Bolt Taps ..... dis 25
Stove Bolt Taps ..... dis 50
Pulley Taps ..... dis 40

Twine.

	BC.	B.
No. 12, Flax Twine, ¼ and ½ lb Balls		21c@29c
No. 18 " " ¼ and ½ "		18c@28c
No. 36 " " ¼ and ½ "		16c@27c
2-Ply Hemp, ¼ & ½ lb Balls (Spring Twine)		11½c
3-Ply " 1 lb Balls		12@12¼c
3-Ply " 1½ lb Balls		11@11¼c
Cotton Wrapping, 5 Balls to lb		15@16c

Vises.

Solid Box ..... dis 60
Parker's ..... dis 20@25
Prentiss ..... dis 20
Stephen's ..... dis 25@30
Barrett's ..... dis 30
Miller's Falls ..... dis 40
Merrill's ..... dis 10@15
Howard ..... dis 30

Wire.

New List, Jan. 18, 1884

Brass and copper ..... dis 20@25
Bright and annealed, Nos. 0@18 ... dis 70&10@75
" " Nos. 19@26 .. dis 75@75& 5
" " Nos. 27@36 .. dis 75&10& 5
Coppered Nos. 0 to 18, market list .. dis 70@70& 5
Galvanized Nos. 0 to 18 " " ..... dis 65&5
Tinned market Nos. 0 to 18 ..... dis 67½
Cast steel ..... dis 50
Tinned Broom Wire ..... dis 70&5@70&10
Annealed Fence, Nos. 8 and 9 ..... dis 75
Annealed Grape, Nos. 10 to 14 ..... dis 75
Stub's Steel Wire regular ..... $6.00@lb dis 30

Wrenches.

Coe's genuine, cash in ten days ..... dis 50
Girard Standard ..... dis 70&10
Agricultural ..... dis 75&10
Mechanics' ..... dis 55&10,& 3
Bemis & Call's Combination ..... dis 35
Donohue's Engineers ..... dis 20&10
Lamson & Sessions Engineers ..... dis 60
Billings & Spencer's Drop Forged ..... dis 10
William's " " ..... dis 10
Alligator " " ..... dis 40

EUCHENHOFER'S
Patent Automatic Feeder
—FOR—
BOILER SCALE SOLVENTS.

Feeds regularly and automatically, so as to keep the water in boiler constantly impregnated with whatever solvent is used. Most effective in the market. Address the manufacturers,

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NOVELTY MACHINE WORKS,
DAYTON, OHIO.

A I. BABBITT.

The only genuine Allen's Black Lead Compound Babbitt. Perfect satisfaction guaranteed. The cheapest metal made, quality considered. Address all orders to

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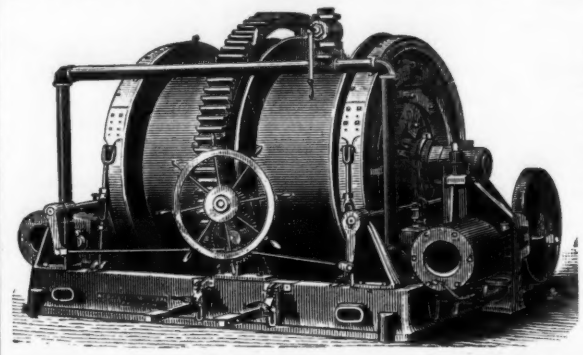
Webster, Camp & Lane Machine Co.



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Improved Band Friction Hoisting Machinery, Geared or Direct Acting, for round or flat rope.
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Automatic or Slide Valve Steam Engines, Sheaves, Cages, Buckets, Etc.

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Lubricator for Traction, Portable and all other small Engines, pumps, etc. Single connection.

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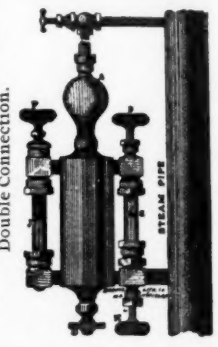
Unique Lubricator Co., Mansfield, O.



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26x26 and 28x28, 30x30, with bed from 6 to 14 ft. long. Address all correspondence to
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N. E. Cor. 8th and Lock, CINCINNATI, O.

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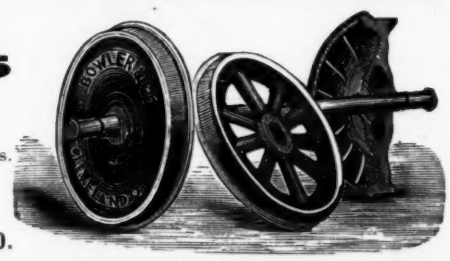
For Machinery and Rolling Mills.
CAR WHEELS
All sizes and kinds, with and without Axles.
Chilled Faced R. R. Frogs
ST. RAILROAD TURNOUTS.
Nos. 9, 11 and 13 Winter Street. } **BOWLER & CO.**



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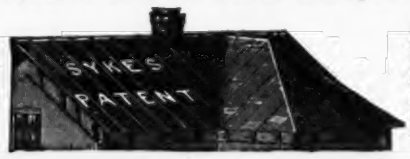
SYKES' IMPROVED Best Roof in the World. Suitable for all classes of Buildings. Easy Put On.



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Send for Circular and Price List, and mention this Paper.

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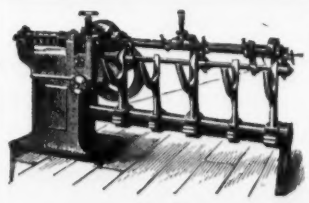
Blast Furnaces, Tanks, Stacks, Stills, Agitators, Car Tanks, Etc.,
REEVES BROS., Props.,
Correspondence solicited. NILES, Trumbull County, O.



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BUILDERS OF
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To Accurate Lengths Direct from the Coil.
Also Machinery for Hardware and other Manufacturing.

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PURE STEEL A SPECIALTY.
Send for Descriptive Catalogue.

HARDWARE MARKET.

Augers and Bits.

Common augers and bits.....dis 70
Nell's.....dis 60&5
Cook's Douglass Mfg. Co.....dis 55
Russell Jennings' augers and bits.....dis 25
Expansive Bits, Clark's small, $18; large, $26.....dis 35@35&5
Hollow Augers, Ives'.....dis 25&10
Hollow Augers, Bonney's Adjust. ₱ doz., $48.....dis 40&10
Hollow Augers, Stearns' Adjust. ₱ doz., $48.....dis 20&10
Gimlet bits, common.....per gross $2 75@3 25
Standard Bit Stock Drills.....dis 50&10&5
Ship Augers.....dis 15&10@15&10&5

Axes.

Makers' and Special Brands—
First quality.....₱dox. $6 00@6 50
Others.....₱doz. $5 50@5 75
Full polished.....$8 00

Bolts.

Cast iron barrel bolts.....dis 70@70&10
Cast iron shutter bolts, etc.....dis 70@70&10
Cast iron chain bolts.....dis 65&10
Ives' patent door bolt.....dis 60
Wrought iron barrel bolts.....dis 70@70&10
Wrought iron square bolts.....dis 70@70&10
Wrought shutter bolts.....dis 60&10
Sargent's list
Carriage, common, new list.....dis 75&10
Tire, common, new list.....dis 70
Carriage and tire, Philadelphia pattern.....dis 75&10
Stove bolts.....dis 62½
Plow bolts.....dis 60&5
Machine.....dis 75&10@80
Ends.....dis 75&10&80

Buckets, Elevator.

.....dis 50&10

Butts.

Wrought brass.....dis 70@70&10
Cast brass, loose joint.....dis 33⅓&10
Cast Iron—
Fast joint, narrow.....dis 50&10&5@60&5
Fast joint, broad.....dis 55&10&5@60&10
Loose joint.....dis 70&10@75
Loose joint, jap.....dis 70&10@75
Loose joint, jap. with acorns.....dis 70&10@75
Loose pin, acorns.....dis 70&10@75
Loose pin, japanned acorns.....dis 70&10@75
Loose pin, acorns, jap. plated tips..dis 70&10@75
Wrought steel—
Wrought, fast joint, narrow.....dis 70&10@75
Wrought, fast joint, broad.....dis 70&10@75
Wrought, loose joint, broad.....dis 70&10@75
Table Butts, back flaps, etc.....dis 70&10@75
Regular inside blind.....dis 70&10@75
Light inside blind.....dis 70&10@75
Loose pin.....dis 70&10@75
Light loose pin.....dis 70&10@75

Chains.

Trace, 6½-10-2.....₱ pair 1.03
Trace, 6½-10-3.....₱ pair .92 } 50&10@50&10&5
Trace, 7-10-2.....₱ pair 1.11
German Halter Chain, list June, 1887...dis 50&10
German Coil, list of June, 1887..dis 50&10&5@60
Galvanized Pump Chain.....₱ lb 5½@6
Jack Chain, Iron.....dis 75@75&5
Jack Chain, Brass.....dis 70@70&5

Chisels.

Socket Framing and Firmer.....dis 75&5@75&10
Socket Framing and Firmer, Buck Bros..dis 30
Socket Firmer and Framing, L. & I. J. White.....dis 30@30&5
Tanged Firmers.....dis 40&10

Cutlery.

Table.....net
Excelsior Pocket.....net

Gimlets.

Nail and Spike.....dis 50&10&5
Double cut, low list.....dis 25
"Bee".....₱ gross $12, dis 25@25&5

Hangers.

Barn door, old patterns.....dis 10&10@70
Climax, (Anti-Friction).....dis 70
Star.....dis 40&10@40&10&5
Scranton.....dis 40
Kidder's.....dis 50&10@60
Terry's Patent.....5 in., $12; 4 in., $10, dis 50&5
Paragon.....dis 40&10
Richard's.....dis 30@30&10

Horse Nails.

	No.	10	9	8	7	6	
Ausable, ₱ lb.		23	24	25	26	28.	dis 25&10@25&10&10
Putnam, ₱ lb.		18	19	20	21	23.	dis 15
Essex							dis 25&10@25&10&10

Horse Shoes.

Burden, at factory.....₱ keg $4 00
R. I. Horshoe Co., Perkins' Imp. at factory.....₱ keg $4 00
Mule Shoes, at factory.....₱ keg $5 00

Knobs.

Carriage, japanned.....₱ gross 80c dis 60&10
Base, rubber tip.....dis 70&10&5
Hemacite door knobs, new list.....dis 40&10@50
Door mineral.....dis 65c@68c
Door Por. japanned.....dis 75c@78c
Door Por. nickle.....$2 00@2 25
Door Por. plated.....$2 00@2 25

Locks, Bolts, Etc.

P. & F. Corbear, Locks and Bronze Goods.
Door locks, knobs and latches.....dis 60
Escutcheons and keys.....dis 60
Padlocks and padlock keys.....dis 66⅔
Bell pulls, mineral, porcelain and jet.....dis 60
Bell pulls, genuine bronze.....dis 60&10
Lever bell pulls, genuine bronze.....dis 60&10
Butts', genuine bronze.....dis 60&10
Butts' bronze plated.....dis 60&10
Store door locks and latches.....dis 60&10
Store door handles.....dis 60&10
Shutter hinges&flaps,genuine bronze.dis 60&10
Shutter hinges, bronze plated.....dis 70
Flush bolts, genuine bronze.....dis 70
Shutter knobs. genuine bronze.....dis 50
Shutter bars, genuine bronze.....dis 60
Sash lifts, genuine bronze.....dis 60
Sash pulls and plates, genuine bronze.....dis 60
Push plates, genuine bronze.....dis 60
Drawer pull, genuine bronze.....dis 66⅔
Letter box plates, genuine bronze....dis 60&10
Barn door locks.....dis 33⅓

Plumbs and Levels.

Standard list.....dis 70&10@70&10&10
Pocket levels.....dis 70&10@70&10&10
Davis' inclinometers.....dis 10&10

Pumps.

Cistern, best makers.....dis 50&10@60
Pitcher spout,best makers.dis 60&10@60&10&10
Pitcher spout,cheaper goods dis 70&5@70&10&5

Rakes.

Cast steel.....dis 65
Malleable.....dis 70@70&5

Razors.

J. R. Torrey Razor Co.....dis 20
Wostenholme & Butcher.....$10@[illegible]...dis 10
Rifle razor.....dis $9 50 net

Scales.

Hatch, Counter, No. 171.....₱ doz $21 00
Hatch, Tea, No. 161.....₱ dox $6 75@7 00
Chatillon's Grocers.....dis 50
Family Turnbulls.....dis 30@30&10
Scale Beams, List of January 12, 1882.....dis 50&10@50&10&4

Screw Drivers.

Stanley R. & L. Co.'s Varnished Handles.....dis 65&10
Stanley R. & L. Co.'s Black Handles..dis 60&10
Sets interchangeables.....₱ doz $18 dis 25

Squares.

Steel and iron } dis 75&10@80
Nickel plated }
Disston's try square and T bevels.....dis 45&10
Winterbottom's try and miter.....dis 30&10

Tacks, Brads, Etc.

New List, January 2, 1888.

American iron carpet tacks all kinds.....dis 80@80&5
Steel carpet tacks all kinds.....dis 80@80&5
Swedes iron carpet tacks, all kinds.....dis 80@80&5
Swedes iron tacks.....dis 75&5@75&10
Swedes iron Upholsterers' tacks.....dis 75&10@75&10&5
Tinned Swedes iron tacks..dis 75&10@75&10&5
Tinned Swedes iron Upholsterers' tacks.....dis 75&10@75&10&5
American iron cut tacks.....dis 75@75&10
Copper tacks.....dis 50&10
Copper finishing and trunk nails.....dis 50&10
Cigar box nails.....dis 50&10@50&10&5
Finishing nails.....dis 70&10@70&10&10
Hungarian nails and miners' tacks.....dis 70&10@70&10&10
Gimp and lace tacks.....dis 75&10@75&10&5
" " " tinned.dis 75&10@75&10&5
Trunk and clout nails.....dis 70&10@70&10&10
Tinned trunk&clout nails.dis 70&10@70&10&10
Basket nails.....dis 70&10@70&10&10
Chair nails.....dis 70&10@70&10&10
Common and patent brads.dis 70&10@70&10&10
Tinned capped trunk n'ls..dis 70&10@70&10&10

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PIPE Coverings,

Hot Blast Abestos Cement, Mineral Wool and Hair-Felt Coverings of every description. The above cut shows REED'S CELEBRATED SECTIONAL COVERING.

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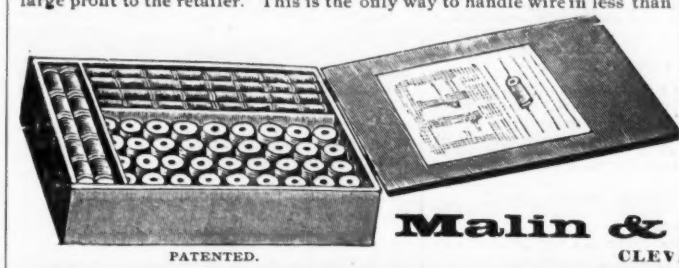
In Painted Wooden Box with Hinged Cover.

This assortment contains over 140 Spools of Black and Tinned Annealed Steel, Copper and Brass Wire, and Comprises almost every size likely to be called for. It has been put up by us especially to meet the demands of the Retail Hardware Trade, and it covers all of the most salable sizes without any dead stock. It will readily bring over $10.00 at retail and represents a large profit to the retailer. This is the only way to handle wire in less than full bundles, as it will not rust, tangle or tarnish, and is convenient for both dealer and consumer. Write us for a net price on the whole assortment, or order it from your jobber.



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Caldwell Sash Balance
Is a Simple, Compact and Durable Device, Superior to all Other Methods for
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It is cheap, easily applied, and gives perfect satisfaction. Adapted to old and new windows, and does not require box frames. Does not get out of order and is a PERMANENT FIXTURE.
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BURGLAR ALARM DOOR KNOBS
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Burglar Window Alarms.
Cheapest, most Reliable and most durable Burglar Alarms on the Market.
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Specially adapted for A No. 1 Boiler Plates, Boiler Rivets, Wire Rods, Stay Bolts, Stamping Ware, Nail Plates, etc. Will contract to completely erect, equip and place in operation blast furnaces, Whitwell stoves and steel plants as above. As I manufacture at my own works, everything appertaining to blast furnace and steel works construction I can guarantee promptness and satisfaction.

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MANUFACTURERS OF
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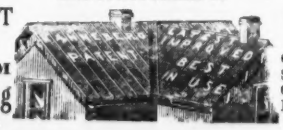
LATEST IMPROVED FOLDED LOCK SEAM
StrictlyGenuine Steel Roofing



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Crimped Edge Iron Roofing and Siding, Beaded Iron Siding and Ceiling, Water Proof Building Paper, Ready-Mixed Paints, Etc.
WRITE FOR CATALOGUE, PRICE LIST AND SAMPLES.

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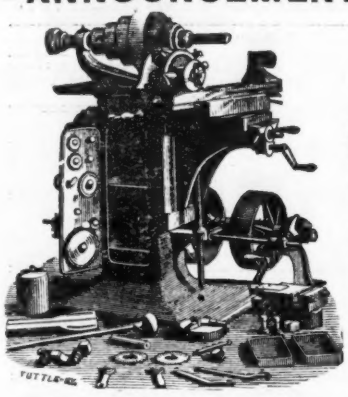

We received **GOLD MEDAL** for our New UNIVERSAL MILLER at the N. O. Exposition. (See cut.)

We have the pleasure of notifying our customers and friends that we have secured a long lease of the new building at Laight and Canal sts., and shall take possession about April 1.

Our new quarters contain about 45,000 square feet of floor room, and has light on three sides. We therefore shall have increased facilities for manufacturing and executing any orders that we may be favored with. Our plant will be a modern one, and all necessary tools for the proper and expeditious finishing of work will be introduced as fast as required.

E. E. GARVIN & CO., Laight & Canal Sts., New York.

Champion Rubber Bucket CHAIN PUMP.

Manufactured by **S. E. Crawford,**
NORWALK, O.

Chain Pump Pipe Buckets, Common & Expansion, Wood Force Pumps; also dealer in Steel Chain–best quality. Special inducements to parties ordering car lots. **Correspondence Solicited.**

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STRONG, WELL BUILT, SERVICEABLE

STEAM ENGINES

12 to 80 HORSE POWER.

Adapted to HEAVY, CONTINUOUS WORK.
EVERY ENGINE TESTED UNDER FULL LOAD.
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CHANDLER & TAYLOR CO. INDIANAPOLIS, IND.

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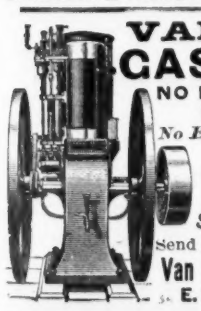

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No Extra WATER RENT or INSURANCE.
INSTANTLY STARTED.
DURABLE, RELIABLE, SAFE and ECONOMICAL.
Send for description and prices.
Van Duzen Gas Engine CO.,
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UNIVERSAL RADIAL AND RADIAL DRILLING MACHINES

THREE DESIGNS. SIX SIZES.
EMBODY ALL DESIRABLE FEATURES
PRICES $450.00 & UPWARD
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Steam Jet Pumps,	-	From $4.00 up.
Automatic Injectors,	-	" $5.00 up.
High Lifting Injectors,		" $6.00 up.
Shafting, Hangers,	- -	" $1.00 up.

COUPLINGS, BOXES, COLLARS, ETC.
Write for Circulars, Etc.
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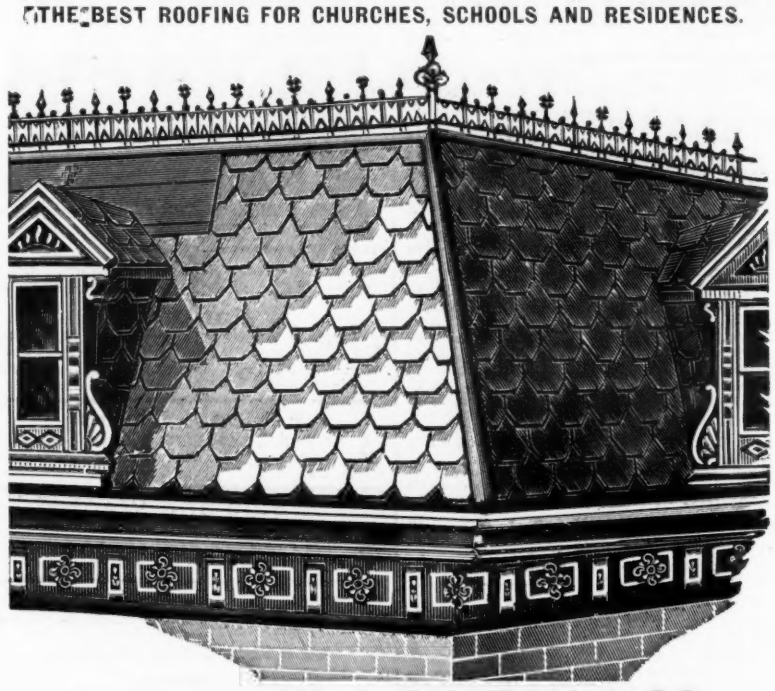
Metallic Shingles and Siding!

THE BEST ROOFING FOR CHURCHES, SCHOOLS AND RESIDENCES.

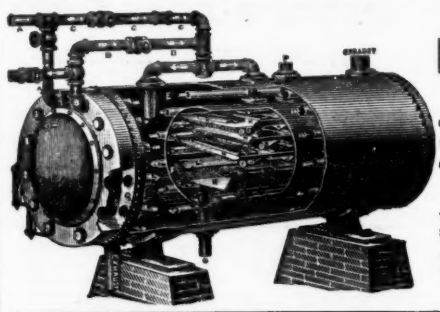


MANUFACTURED BY **W. J. BURTON & CO.,**
SUCCESSORS TO
THE DETROIT METALLIC SHINGLE CO., Cor. State and Park Place, Detroit, Mich.

THE - ARMSTRONG - PURIFIER,

WITH

EXHAUST HEATER COMBINED.



Purifies the feed water by means of the live steam, and heats the water up to the boiling point by means of exhaust steam.

A full description of this heater, together with a valuable treatise on steam boilers, sent to any address, free of charge. Address,

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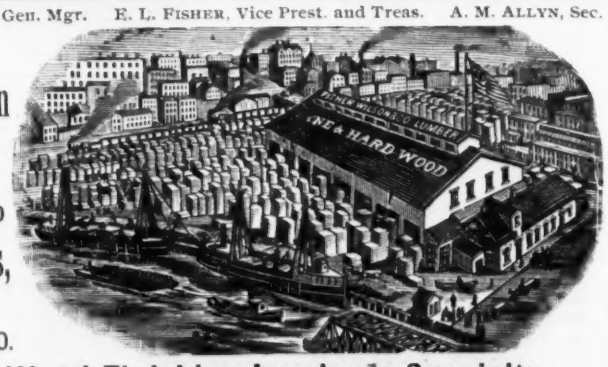

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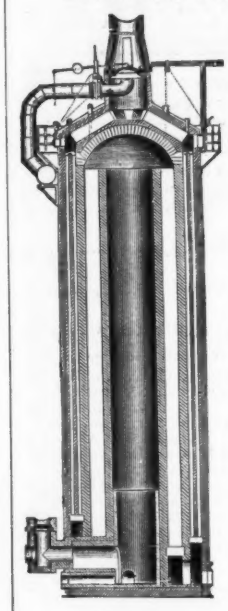

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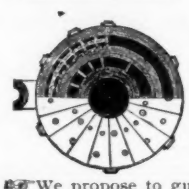

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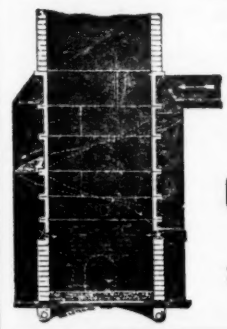

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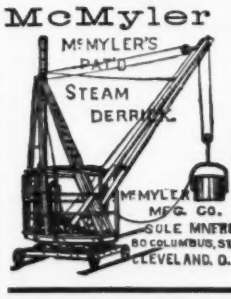

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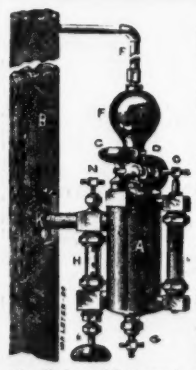

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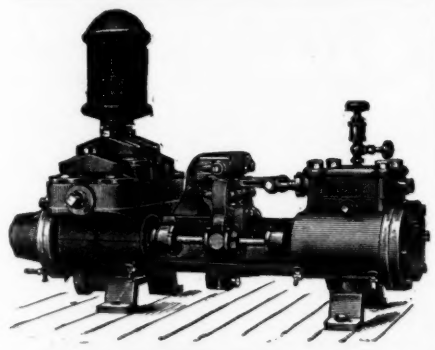

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Standard Time.
Revised March 6th, 1888.

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Buffalo Passenger	10 40 a m	10 45 a m
Chicago Passenger	9 20 p m	.....
Local Freight	4 40 p m	7 30 a m
Westward.	**Arrive.**	**Depart.**
Chicago Passenger	.....	6.30 a m
Fostoria Passenger	5 06 p m	5 11 p m
Local Freight	1 00 p m	5 50 a m

Rocky River Accommodation departs 7:40 a. m.; 1:40 p. m.

Euclid Accommodation departs 6:24 a. m.; 5.05 p. m.

All trains daily, except Sunday.

Cleveland & Pittsburgh.

	Arrive.	Depart.
New York Express	12 50 p m	7 45 a m
New York Express	6 35 p m	1 05 p m
Alliance & Akron Accom	9 35 a m	3 25 p m
Ravenna Accommodation	8 25 a m	5 00 p m
Night Express	*5 25 a m	*11 10 p m

*Daily; all other trains daily, except Sunday.

Mt. Vernon & Pan Handle Route.

C., A. & C. Ry. Co.	Arrive.	Depart.
Akron, Col. & Cin. "Flyer"	5 40 p m	8 10 a m
Akron, Col. & Cin. Night Express	7 00 a m	8 00 a m
Akron, Col. & Zanesv'e Ex	12 50 p m	1 95 p m
Akron & Orrville Accom	9 35 a m	3 25 p m

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N. Y. & Pitts. Express	‡5 38 a m	*8 25 a m
Fast N. Y. & Pitts. Express	*10 55 a m	*3 00 p m
Mahoning Accommo	.....	†6 40 a m
Pittsburgh Express	†6 25 p m	.....
Youngstown Local	†8 05 a m	.....
Mahon'g div. & Pitts Local	.....	*11 40 a m
Mahoning Val. Accom	.....	†4 30 p m
Pittsburgh Express	†1 20 p m	11 10 p m
New York Express	*8 00 p m	.....

*Daily. †Daily, except Sunday. ‡Daily except Monday.

Cleveland & Canton Railroad.

Depart—
Canton and Coshocton—7:30 a. m., 4:05 p. m.
Bedford—7:30 a. m., *9:00 a. m., 11:10 a. m., 2:00 p. m., 4:05 p. m., 5:45 p. m., *8:15 p. m.
Newburgh—6:10 a. m., 7:30 a. m., *9:00 a. m., 11:10 a. m., 2.00 p. m., 4:05 p. m., 5:45 p. m., *8:15 p. m.
Kent—7:30 a. m., *9:00 a. m., 4:05 p. m., *8:15 p. m.
Arrive from—
Canton and Coshocton—9:50 a. m., 6:25 p. m.
Bedford—6:00 a. m., *7:40 a. m., 9:50 a. m., 1:05 p. m., 4:15 p. m., 6:25 p. m., *7:15 p. m.
Newburgh—6:00 a. m., 7:10 a. m., *7:40 a. m., 9:50 a. m., 1.05 p. m., 4:15 p. m., 5:35 p. m., 6:25 p. m., *7:15 p. m.
Kent—*7:40 a. m., 9:50 a. m., 6:25 p. m., *7:15 p. m.

Theatre train leaves Cleveland every Saturday night for Newburgh and Bedford 10:35 p. m.

Trains marked with * run daily. All others daily, except Sunday.

Depot at Ontario St., opposite Huron St.

Valley Railway.

FOR AKRON, CANTON AND MARIETTA
Depot foot South Water Street.

	Depart.	Arrive.
Valley Junction Mail	*7 45 a m	*6 30 p m
Marietta Express	†11 15 a m	†2 30 p m
Valley Junction Express	*4 15 p m	*10 15 a m
Cleve. and Canton Express	*7 00 p m	†8 15 a m

*Daily. †Daily, except Sunday.

WM. THORNBURGH, Gen. Manager. R. A. CARRAN, Gen. Pass. Agt.

Cleveland, Lorain and Wheeling.

All trains arrive and leave the Union Depot as follows:

	Depart.	Arrive.
Wheeling Express	6 45 a m	6 55 p m
Uhrichsville Express	4 00 p m	9 20 a m

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No. 72, New York Express	* 8 30 a m
No. 72, Fast Pittsburgh Express	* 8 30 a m
No. 64, Fast Pittsburgh Express	* 3 00 p m
No. 66, Mantua Accommo	* 4 20 p m
No. 68, Pittsburgh Express	†10 50 p m
No. 68, New York Express	†10 50 p m
No. 70, Pittsburgh Local Express	†11 40 a m
No. 74, Youngstown Express	† 4 20 p m
	Arrive.
No. 65, Fast New York Express	*12 50 p m
No. 61, Pittsburgh Express	* 7 35 a m
No. 67, Pittsburgh Express	†10 55 a m
No. 63, New York Express	* 6 50 p m
No. 63, Pittsburgh Express	* 6 50 p m
No. 69, Pittsburgh Local Express	† 9 00 p m
No. 73, Accommodation	† 7 25 p m

*Daily. †Daily, except Sunday.

Baggage checked through to all points East.

Through tickets and information regarding the route can be obtained at office, 141 Superior street, and at Depot N. Y., P. & O. Railroad, South Water street and Viaduct, Cleveland.

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L. P. FARMER, Gen. Pass. Agt., New York.
W. C. RINEARSON, Ass't G. P. A., Cleveland, O.
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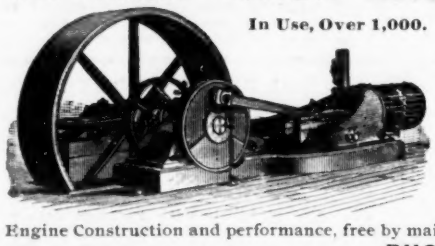

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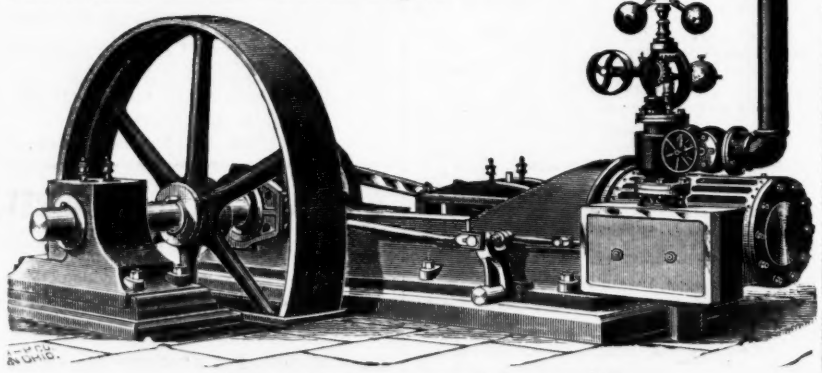

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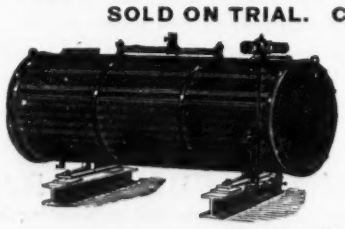

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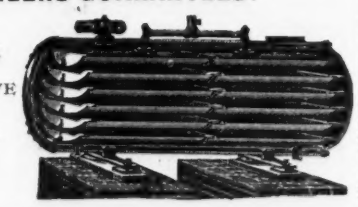

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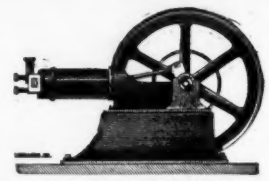

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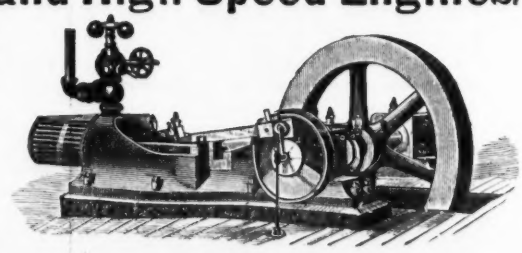

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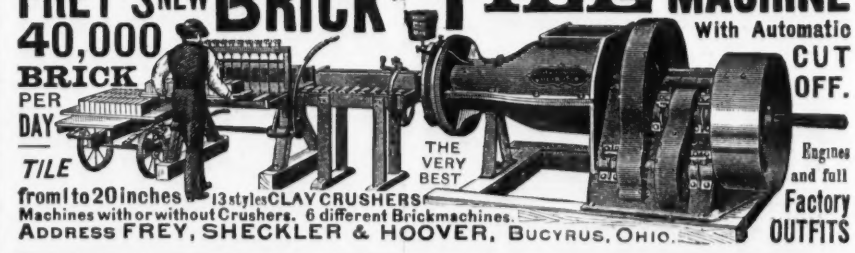

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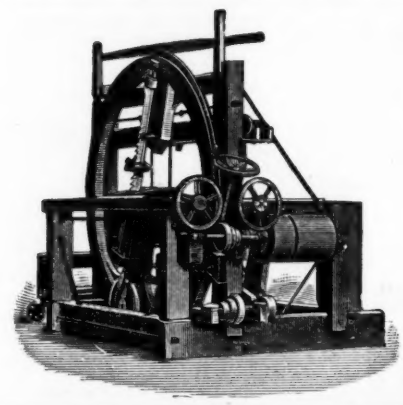

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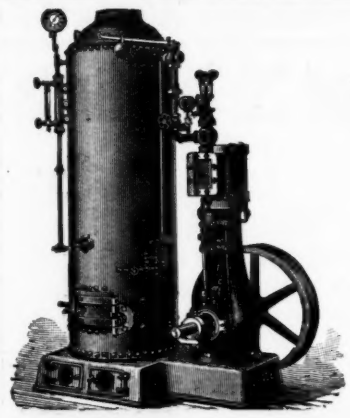

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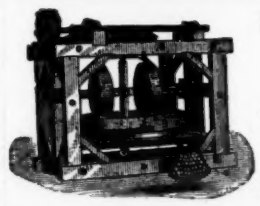

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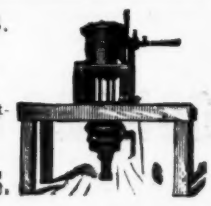

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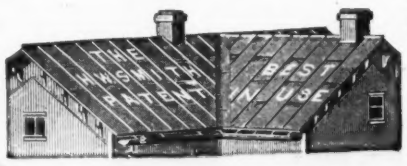

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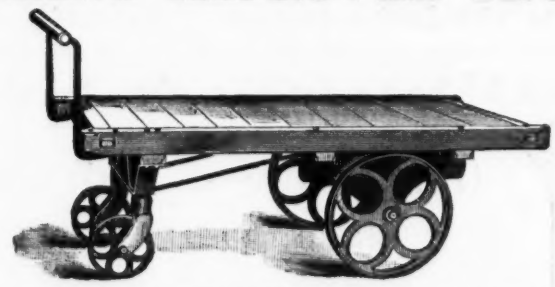

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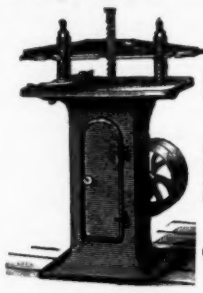

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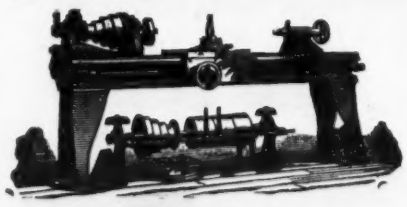

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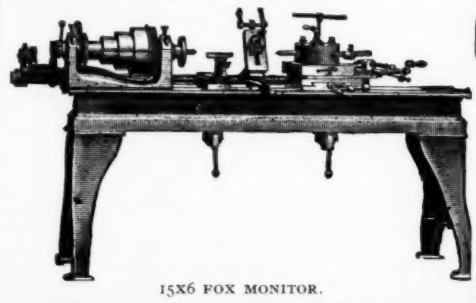

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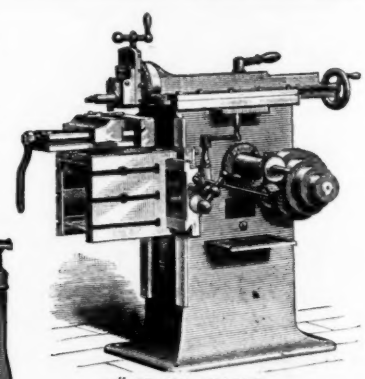

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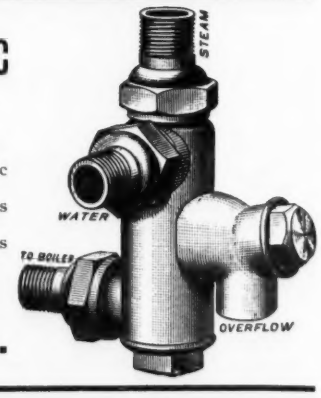

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